



EPB/SLR

PHI/3 (ARR 4) vol 6 pt 2

904

16

















T H E

# PHILOSOPHICAL TRANSACTIONS

(From the Year 1719, to the Year 1733)

ABRIDGED,

A N D

Dispos'd under General H E A D S.

---

By Mr JOHN EAMES, *F. R. S.*

A N D

JOHN MARTYN, *F. R. S.* Professor of *Botany*  
in the University of *CAMBRIDGE*.

---

VOL. VI. PART II.

---

Containing the *PHYSIOLOGICAL* Papers.

---

L O N D O N:

Printed for J. BROTHERTON, J. HAZARD, W. MEADOWS,  
T. COX, W. HINCHLIFFE, W. BICKERTON, T. ASTLEY,  
S. AUSTEN, L. GILLIVER, and R. WILLOCK. 1734.

T H F

# PHILOSOPHICAL TRANSACTIONS

From the Year 1750 to the Year 1769

A BRIDGE

AND

Disposal under General Law

20610



VOL VI PART II

Containing the Philosophical Papers

OF THE

ROYAL SOCIETY OF LONDON  
Printed by W. Woodman, at the Royal Society, in Pall Mall  
1770





THE  
Philosophical Transactions  
ABRIDGED.

---

PART II.  
CONTAINING THE  
*Physiological* PAPERS.

---

CHAP. I.  
PHYSIOLOGY, METEOROLOGY, PNEUMATICS.

I. 1. **T**HE Account we have of the Universal Deluge is no where so express as in the Holy Scriptures; and the exact Circumstances as to point of Time, do shew that some Records had been kept thereof more particularly than is wont in those things derived from remote Tradition, wherein the Historical *Minutiæ* are lost by length of Time. But the same seem much too imperfect to be the Result of a full Revelation from the Author of this dreadful Execution upon Mankind, who would have spoken more amply as to the Manner thereof, had He thought fit to lay open the Secrets of Nature to the succeeding Race of Men; and I doubt not but to all that consider the 7th Chapter of *Genesis* impartially, it will pass for the Remains of a much fuller Account of the *Flood* left by the Patriarchs to their Posterity, and derived from the Relation of *Noah* and his Sons. It must

*Some Considerations about the Cause of the Universal Deluge, laid before the Royal Society, on the 12th of Dec. 1694. by Dr Edmond Halley, R. S. S. No. 383. p. 118.*

VOL. VI. Part. ii. A be



*Considerations on the Cause of the Universal Deluge.*

be granted, that there are some Difficulties as to the Construction of the *Ark*, the Reception and Agreement of the *Animals* among themselves, and Preservation of it in so immense and boundless an Ocean, during that *Wind* which God sent to dry the Waters away, especially when it first came on Ground: But it must also be allowed, that length of Time may have added, as well as taken away many notable Circumstances, as in most other Cases of the Story of remote Times and Actions.

Certainty of  
an Universal  
Deluge.

This we may, however, be fully assured of, that such a Deluge has been; and by the many Signs of marine Bodies found far from and above the Sea, 'tis evident, that those Parts have been once under Water: or, either that the Sea has risen to them, or they have been raised from the Sea; to explicate either of which is a Matter of no small Difficulty, not does the sacred Scripture afford any Light thereto. All that it says to help us is, that all the Fountains of the great Deep, *וְהַיְוֹת רַבִּים* were burst, or broken up; that the Windows, or Cataracts, of Heaven were opened, and that it rained incessantly forty Days and Nights. Now the Rain of forty Days and Nights will be found to be a very small Part of the Cause of such a Deluge; for supposing it to rain all over the Globe as much in each Day, as it is now found to do in one of the most rainy Counties of *England* in the whole Year, viz. about forty Inches of Water *per Diem*; forty such Days could cover the whole Earth with but about twenty two Fathom Water, which would only drown the low Lands next the Sea, but the much greater Part would escape. What is meant by the Fountains of the *Abyss* being broken up, and the opening of the Windows of Heaven, seems not so easy to be understood, but is intended to indicate the *Modus* of the Deluge, which was, according to the *Mosaic Philosophy*, from the letting in of the Waters above the Firmament, mentioned *Genesis* i. 7. by the Windows of Heaven; and the rising up out of the Ground of the Waters under the Earth, spoken of in the second Commandment: Or, (if you will understand that by the *וְהַיְוֹת רַבִּים* is meant the great Ocean) by the overflowing of the Sea rising upon the Land, which is express'd by the breaking up of the Fountains of the great Deep. So that we may reasonably conclude, that by the one of those Expressions is meant an extraordinary Fall of Waters from the Heavens, not as Rain, but in one great Body; as if the Firmament, supposed by *Moses* to sustain a *Supra-aërial Sea*, had been broken in, and at the same Time the Ocean did flow in upon the Land, so as to cover all with Water.

*Abyss.*

By an extraordinary Encrease of the Waters this could not be effected, for that at this Time there is not Water sufficient of itself to cover any more of the Earth than now it doth; and to suppose a Creation and Annihilation of Water on purpose to destroy the Earth, is by much the most difficult Hypothesis that can be thought of to effect it. A change of the Center of Gravity, about which Center the Sea



## Considerations on the Cause of the Universal Deluge.

3

is formed, seemed not an improbable Conjecture, till it appeared that this Center of Gravity was the necessary Result of the Materials of which our Globe consists, and not alterable whilst the Parts thereof remained in the same Position; And besides this Supposition could not drown the whole Globe, but only that Part thereof towards which the Center of Gravity was translated, leaving the other Hemisphere all dry.

I shall say nothing of Dr Burnet's Hypothesis, nor of the many Insufficiencies thereof, as jarring as much with the Physical Principles of Nature, as with the Holy Scriptures, which he has undertaken to reconcile. Dr Hook's Solution of this Problem, as he has not fully discovered himself, I cannot undertake to judge of; but his Compression of a Shell of Earth into a *prolate Spheroid*, thereby pressing out the Waters of an Abyss under the Earth, may very well account for drowning two extream opposite Zones of the Globe: but the middle Zone, being by much the greater Part of the Earth's Surface, must by this means be raised higher from the Center, and consequently arise more out of the Water than before; and besides, such a Supposition cannot well be accounted for from Physical Causes, but require a preternatural *digitus Dei*, both to compress, and afterwards restore the Figure of the Globe.

But the Almighty generally making use of Natural Means to bring about his Will, I thought it not amiss to give this Honourable Society an Account of some Thoughts that occur'd to me on this Subject; wherein, if I err, I shall find myself in very good Company.

In Num. 190. of these Transactions. I have proposed the casual *Choc* *Choc of a Comet.* of a Comet, or other transient Body, as an Expedient to change instantly the Poles and Diurnal Rotation of the Globe; at that Time only aiming to shew how the *Axis* of the *Earth* being chang'd, would occasion the Sea to recede from those Parts towards which the Poles did approach, and to encrease upon and overflow those Parts wherefrom the Poles were departed; but at that Time I did not consider the great Agitation such a *Choc* must necessarily occasion in the Sea, sufficient to answer for all those strange Appearances of heaping vast Quantities of Earth and high Cliffs upon Beds of Shells, which once were the Bottom of the Sea; and raising up Mountains where none were before, mixing the Elements into such a Heap as the Poets describe the *old Chaos*; for such a *Choc* impelling the solid Parts would occasion the Waters, and all fluid Substances that were unconfined, as the Sea is, with one *Impetus* to run violently towards that Part of the Globe where the Blow was received; and that with Force sufficient to rake with it the whole Bottom of the Ocean, and to carry it upon the Land; heaping up into Mountains those earthy Parts it had born away with it, in those Places where the opposite Waves balance each other, *miscens ima summis*, which may account for those long continued Ridges of Mountains. And again, the Recoil of this Heap of Waters would return



## Considerations on the Cause of the Universal Deluge.

towards the opposite Parts of the Earth, with a lesser *Impetus* than the first, and so reciprocating many times, would at last come to settle in such a Manner as we now observe in the Structure of the superficial Parts of the Globe.

In this Case it will be much more difficult to shew how *Noah* and the *Animals* should be preserved, than that all things in which was the Breath of Life, should hereby be destroyed. Such a *Choc* would also occasion a differing Length of the Day and Year, and change the Axis of the Globe, according to the Obliquity of the Incidence of the Stroke, and the Direction thereof, in relation to the former Axis. That some such thing has happened, may be guessed, for that the Earth seems as if it were new made out of the Ruins of an old World, wherein appear such Animal Bodies as were before the Deluge, but by their own Nature and Defences from the Weather, have endured ever since, either petrified, or else entire in *statu naturali*. Such a *Choc* may have occasioned that vast Depression of the *Caspian Sea*, and other great Lakes in the World; and 'tis not unlikely, but that extrem Cold felt in the North-West of *America*, about *Hudson's-Bay*, may be occasioned by those Parts of the World having once been much more Northerly, or nearer the Pole than now they are; whereby there are immense Quantities of Ice yet unthaw'd in those Parts, which chill the Air to that degree, that the Sun's Warmth seems hardly to be felt there, and of which the Poet might justly say, *Frigus iners illic habitat pallorque tremorque—Ac jejuna fames*.

Some farther  
Thoughts upon  
the same Subject,  
delivered on the 19th of  
the same  
Month, by the  
same. Ibid.  
p. 123.

2. I have been advised since the last Day, by a Person whose Judgment I have great Reason to respect, that what I then advanced, ought rather to be understood of those Changes which might have happened to the Earth in Times before the Creation, and which might possibly have reduced a former World to a *Chaos*, out of whose Ruins the present might be formed, than of the Deluge whereby Mankind was in a manner extinguished about 4000 Years since; that being much more gradually brought to pass, and with some Circumstances that this Hypothesis cannot admit of, which abler Pens, perhaps, may account for: What I have advanced, I desire may be taken for no more than the Contemplation of the Effects of such a *Choc* as might possibly, and not improbably, have befallen this Lump of Earth and Water in Times whereof we have no manner of Tradition, as being before the first Production of Man, and therefore not to be known but by Revelation, or else *à posteriori* by Induction from a convenient Number of Experiments or Observations, arguing such an Agitation once, or oftner, to have befallen the Materials of this Globe. And perhaps in due Periods of Time, such a Catastrophe may not be unnecessary for the well-being of the future World; to bury deep from the Surface those Parts, which by length of time are indurated into stony Substances, and become unapt for vegetable Production, by which all Animals are either immediately or mediately sustained



## *The Cause of Cohesion of the Parts of Matter.*

sustained: the ponderous Matter in such a Mixture subsiding first, and the lighter and finer Mould remaining for the latter Settling, to invest the exterior Surface of the New World. This may, perhaps, be thought hard, to destroy the whole Race for the Benefit of those that are to succeed. But if we consider Death simply, and how that the Life of each Individual is but of a very small Duration, it will be found that as to those that die, it is indifferent whether they die in a Pestilence out of 100000 *per Ann.* or ordinarily out of 25000 in this great City, the Pestilence only appearing terrible to those that survive to contemplate the Danger they have escaped. Besides, as *Seneca* has it,

*Vitæ est avidus quisquis non vult  
Mundo secum pereunte mori.*

N.B. The foregoing Papers having been read before the Society thirty Years since, were then deposited by the Author in their Archives, and not published; he being sensible that he might have adventured *ultra crepidam*: and apprehensive least by some unguarded Expression he might incur the Censure of the Sacred Order. Nor had they now been printed but at the Desire of a late Committee of the Society, who were pleased to think them not unworthy of the Press.

Here the Reader is desired to observe, that Mr William Whiston's Book, entituled, A New Theory of the Earth, was not published till about a Year and a half after the Date hereof, and was not presented before June 24, 1696. to the Royal Society.

II. Query I. Does not the strong Cohesion of two Balls of Lead prove the Doctrine of Attraction, worthy its great Author, Sir Isaac Newton; and that there is an universal Attraction between the Parts of Matter in Nature, though some at such small Distances as to escape our Observations, since we cannot make their Parts touch one another close enough, so as to come within their Sphere of Activity? Which I presume to be the Reason why I never have been able to make Balls of any other Metals to cohere: Nor do I believe that the Parts of any other Metal can come to such a close Contact, except by Fusion, as the Particles of Lead may, by being so many Degrees softer than those of any other Metal.

*Queries concerning the Cause of Cohesion of the Parts of Matter, by Fr. Triewald, Director of Mechanicks in the Kingdom of Sweden. No. 408. p. 39.*

Query II. I have often found the touching Surfaces of such Leaden Balls, as near as I could measure, much alike; yet the Force of Cohesion very different: Nay, I have found the touching Surfaces very small, yet sometimes 114 to 126  $\text{lb}$  Weight has not been sufficient to separate them; when at other times a far less Weight (though the Measure of touching Surfaces far exceeded those mentioned) was more than sufficient to cause their Separation. Does it not prove that the Cohesion is strongest according to the closeness of the Contact, but not as the touching Surfaces? For which Reason I always have found



## *The Cause of Cohesion of the Parts of Matter*

the Cohesion strongest, when I gave a little twist in joining them; since by this Means the Particles must come closer together, than by squeezing the Balls barely on one another, though it was done with a far greater Force than I could apply with my bare Hands. And since the Force, Twist, and touching Surfaces can never be alike and mensurable when joined by Hand, I think it will be very difficult, if not impossible, to ascertain the Forces of this Cohesion, which is incredible, and far exceeds Magnetical Attractions.

That the Pressure of the Atmosphere contributes little, and next to nothing in this Cohesion, I have fully proved and experienced last Winter, before a great and noble Assembly: The Cohesion of two Leaden Balls, which 126 lb could not separate, proved as strong in *Vacuo*, as in the open Air.

*Query III.* Does not this Experiment fairly account for the Cohesion of the Parts of Matter; and that this firm Cohesion cannot be derived from any Glue or Cement, any imaginary Hooks and *Funiculus*, nor *de gravitate Ætheris*: but that the Particles of all solid and fluid Bodies do attract one another by a certain Force (whatever be the Cause of the same) which acts most intensely the nearer they touch one another.

I am confirmed in this Opinion by an Experiment I made this Summer at *Dannemora*, one of the most considerable Iron Mines, and where I have erected the first and largest Fire-Engine for drawing Water and Oar in this Kingdom; the Cylinder being two Lines more than thirty-six Inches in Diameter.

Our *Dablkarlians* have, Time out of Mind, practised the said Experiment, when they have had Occasion to remove any unweildly Stones of the hardest Rocks, and so big as not to be moved intire by any Strength they could apply. They practise the following Means, not only to cleave and split them in as many Parts and Pieces as they please, but to obtain Stones with one or more smooth Sides, fit for Use in Buildings.

They take Tallow, Greese, Train Oil, or any other fat Substances, and draw Lines on such large Stones, according as they would have them split, and think proper; then they lay either Charcoal or Wood at Top, and round the Sides of the Stone, so that it is all over covered, and then kindle the Fuel; which when burned out, they find the Stone divided according to the Lines they have drawn on it, with some of the before-mentioned fat Substances, which seldom or never fails.

May one not account for this odd *Phænomenon* thus? That as the Action of Heat and Fire expands the Parts of all hard and solid Bodies and Metals themselves, so when the Action of the Fire about the Stone has made the Particles of the same recede farther from one another, than when in their natural State, the oily Substances insinuate themselves



themselves more and more between the Particles of the Stone; by which Means, when the Stone cools again, and shrinks, they seem to prevent these Particles from coming as close, and within their Sphere of Activity, as the remaining Particles may, where no such foreign Matter has been applied; by which Means they also cannot attract one another so strongly as the rest, and must therefore remain separated.

Fat and oily Substances seem to be most fit for this Purpose, since they are endued with a repelling Force.

I cannot but admire, that notwithstanding so many *Phænomena* in Nature prove a Tendency and a strong mutual Attraction of the Parts of Matter, whatever be the Cause, yet most learned Men, of several Nations, would rather charge such manifest Qualities and Operations of Nature with the Nick-Name of occult Qualities, than give the Honour to the *great Discoverer (who is no more)* of those manifest Qualities and Principles of Motion. However, I am confident, that as Nature is very uniform and agreeable to herself, she will evince the Truth of her Operations.

III. 1. Having often observed in the Electrical Experiments made with a glass Tube, and a down Feather tied to the end of a small Stick, that after it's Fibres had been drawn towards the Tube, when that has been withdrawn, most of them would be drawn to the Stick, as if it had been an Electrick Body, or as if there had been some Electricity communicated to the Stick or Feather; this put me upon thinking, whether if a Feather were drawn thro' my Fingers, it might not produce the same effect, by acquiring some degree of Electricity. This succeeded accordingly upon my first trial, the small downy Fibres of the Feather next the Quill being drawn by my Finger when held near it: and sometimes the upper part of the Feather, with it's Stem, would be attracted also; but not always with the same Success. I then proceeded to try whether Hair might not have the same property, by taking one from my Wig, and drawing it 3 or 4 times through my Fingers, or rather between my Thumb and Forefinger, and soon found it would come to my Finger at the distance of half an Inch; and soon after I found that the fine Hair of a Dog's Ear was strongly Electrical; for upon taking the Ear and drawing it thro' my Fingers; great numbers of them would be attracted to my Fingers at once. The next thing which I thought of, was threads of Silk of several Colours, and of several finenesses, which I found to be all Electrical, but sometimes I could not succeed; the reason of which I afterwards found, as will appear in the sequel of this Discourse.

Having succeeded so well in these, I proceeded to larger quantities of the same Materials, as pieces of Ribband both of coarse and fine Silk of several colours, and found that by taking a piece of either of these of about half a yard long, and by holding the end in one hand, and drawing,

*New Electrical Experiments, by Mr Stephen Gray, No 366. p. 104.*



## *New Electrical Experiments.*

drawing it thro' my other Hand between my Thumb and Fingers, it would acquire an Electricity, so that if the Hand were held near the lower end of it, it would be attracted by it at the distance of 5 or 6 Inches; but at some times the Electricity would be much weaker than at others, the reason of which I conjectured to be, that the Ribband might have imbib'd some aqueous Particles from the moist Air, which I found to be upon trial the occasion of it; for when I had well warmed the Ribband by the Fire, it never failed to be strongly Electrical.

After this I made trial of several other Bodies, as Linnen of several sorts, *viz.* Holland, Muslin, &c. And Woollen, as of several sorts of Cloth and other Stuffs of the same Materials. From these I proceeded to Paper, both white and brown, finding them, after they had been well heated before rubbing, to emit copiously their Electric Effluvia. The next Body in which I found the same Property, was thin Shavings of Wood; I have only as yet tried the first Shavings, which are strongly Electrical. The three last substances which I found to have the same property, are Leather, Parchment, and those thin Guts wherein Leaf-Gold is beaten.

All these Bodies will not only by their Electricity be drawn to the Hand, or any other solid Body that is near them; but they will, as other Electrick Bodies do, draw all small Bodies to them, and that to the distance of sometimes 8 or 10 Inches. Heating them by the Fire before rubbing very much increases their Force. There is another property in some of these bodies, which is common to Glass, that when they are rubbed in the dark, there is a Light follows the Fingers through which they are drawn, this holds both in Silk and Linnen, but is strongest in Pieces of white pressing Papers, which are much the same with Card-Paper; this not only yields a Light as above, but when the Fingers are held near it, there proceeds a Light from them with a crackling Noise, like that produced by a Glass Tube, though not at so great a distance from the Fingers; to perform this, the Paper before rubbing must be heated as hot as the Fingers can well bear.

A Down Feather being tied to the end of a fine Thread of raw Silk, and the other end to a small stick, which was fixed to a Foot, that it might stand upright on the Table; there was taken a piece of brown Paper, which by the abovementioned Method was made to be strongly Electrical, which being held near the Feather, it came to the Paper, and I carried it with the same till it came near the Perpendicular of the Stick; then lifting up my Hand till the Paper was got beyond the Feather, the Thread was extended and stood upright in the Air, as if it had been a piece of Wire, tho' the Feather was distant from the Paper near an Inch. If the Finger were held near the Feather in this Position, the greatest part of the Fibres next the Paper would be repelled, when at the same time if a Finger were held to the Fibres that were more remote from the Paper, they would be drawn by it.

I then



## *More Experiments concerning Electricity.*

I then repeated this Experiment without the Feather, viz. by a single thread of Silk only of about 5 or 6 Inches long, which was made to stand extended upright as abovementioned, without touching the Paper; then placing my Finger near the end, it would avoid, or was repelled by it, but when I had placed my Finger at about the same distance from a part of the Thread, that was about two Inches from the end, it was then attracted by it.

An Enumeration of the several Bodies mentioned herein, that are found to be Electrical.

1. Feathers, 2. Hair, 3. Silk, 4. Linnen, 5. Woollen, 6. Paper, 7. Leather, 8. Wood, 9. Parchment, 10. Ox-guts, wherein Leaf-Gold is beaten.

2. In *February* 1728, I repeated some of the Experiments I had formerly made, in the first Discovery of an Electrical Attraction in many Bodies, not before known to have that Property, I made several Attempts on the Metals, to see whether they might not be made attractive by the same Method as other Bodies were, viz. by heating, rubbing and hammering, but without any Success: I then resolved to procure me a large Flint-Glass Tube, to see if I could make any farther Discovery with it, having called to Mind a Suspicion which some Years ago I had, that as the Tube communicated a Light to Bodies, when it was rubbed in the Dark, whether it might not at the same Time communicate an Electricity to them, though I never till now tried the Experiment, not imagining the Tube could have so great and wonderful an Influence, as to cause them to attract with so much Force, or that the Attraction would be carried to such prodigious Distances, as will be found in the Sequel of this Discourse.

*More Experiments concerning Electricity; by Mr. Stephen Gray. No 417. p. 18.*

Before I proceed to the Experiments, it may be necessary to give a Description of the Tube: It's Length is three Feet five Inches, and near one Inch two Tenths in Diameter: I give the mean Dimensions, the Tube being larger at each End than in the Middle, the Bore about one Inch. To each End I fitted a Cork, to keep the Dust out when the Tube was not in use.

The first Experiment I made, was to see if I could find any Difference in it's Attraction, when the Tube was stopped at both Ends by the Corks, or when left open, but could perceive no sensible Difference; but upon holding a Down-Feather over against the upper End of the Tube, I found that it would go to the Cork, being attracted and repelled by it, as by the Tube when it had been excited by rubbing. I then held the Feather over against the flat End of the Cork, which attracted and repelled many Times together; at which I was much surprized, and concluded that there was certainly an attractive Virtue communicated to the Cork by the excited Tube.

I fixed an Ivory Ball of about one Inch three Tenths Diameter, with a Hole through it, upon a Fir-Stick about four Inches long, thrusting the other End into the Cork, and upon rubbing the Tube,



*More Experiments concerning Electricity.*

found that the Ball attracted and repelled the Feather with more Vigour than the Cork had done, repeating its Attractions and Repulsions for many Times together: I then fixed the Ball on longer Sticks, first upon one of eight Inches, and afterwards upon one of twenty-four Inches long, and found the Effect the same. Then I made use first of Iron, and then Brass Wire, to fix the Ball on, inserting the other End of the Wire in the Cork, as before, and found that the Attraction was the same as when the Fir-Sticks were made use of, and that when the Feather was held over against any Part of the Wire, it was attracted by it; but though it was then nearer the Tube, yet its Attraction was not so strong as that of the Ball. When the Wire of two or three Feet long was used, its Vibrations caused by rubbing the Tube, made it some what troublesome to be managed: This put me upon thinking, whether if the Ball was hung by a Packthread, and suspended by a Loop on the Tube, the Electricity would not be carried down the Line to the Ball: I found it to succeed accordingly; for upon suspending the Ball on the Tube by a Packthread about three Feet long, when the Tube had been excited by rubbing, the Ivory Ball attracted and repelled the Leaf-Brass, over which it was held, as freely as it had done, when it was suspended on Sticks or Wire; as did also a Ball of Cork, and another of Lead that weighed one Pound and a quarter.

After I had found that the several Bodies abovementioned had an Electricity communicated to them, I then went on to see upon what other Bodies the Tube would have the same Effect, beginning with the Metals, suspending them on the Tube by the Method abovementioned; first in small Pieces, as with a Guinea, a Shilling, a Half-penny, a Piece of Block-Tin, a Piece of Lead; then with larger Quantities of Metal, suspending them on the Tube by Packthread: Here I made use of a Fire-Shovel, Tongs, and Iron Poker, a Copper Tea-Kettle, which succeeded the same, whether empty, or full of either cold or hot Water; a Silver Pint Pot; all which were strongly Electrical, attracting the Leaf-Brass to the Height of several Inches. After I had found that the Metals were thus Electrical, I went on to make Trials on other Bodies, as Flint-Stone, Sand-Stone, Load-Stone, Bricks, Tiles, Chalk; and then on several Vegetable Substances, as well green as dry, and found that they had all of them an Electric Virtue communicated to them, either by being suspended on the Tube by a Line, or fixed on the End of it by the Method abovementioned.

I next proceeded to try at what greater Distances the Electric Virtue might be carried; and having by me Part of a hollow walking Cane, which I suppose was Part of a Fishing-Rod, two Feet seven Inches long; I cut the great End of it, to fit it into the Bore of the Tube, into which it went about five Inches; then when the Cane was put into the End of the Tube, and this excited, the Cane drew the

Leaf



Leaf-Brass to the Height of more than two Inches, as did also the Ivory Ball, when by a Cork and Stick it had been fixed to the End of the Cane. A solid Cane had the same Effect, when inserted in the Tube after the same Manner as the hollow one had been. I then took the two upper Joints of a large Fishing-Rod, the one of *Spanish* Cane, the other partly Wood and the upper End Whale-bone, which, together with the Tube, made a Length of more than fourteen Feet. Upon the lesser End of the Whale-bone was fixed a Ball of Cork of about an Inch and quarter Diameter; then the great End of the Rod being inserted in the Tube, the Leaf-Brass laid on the Table, and the Tube excited, the Ball attracted the Leaf-Brass to the Height of about three Inches by Estimation. With several Pieces of *Spanish* Cane and Fir-Sticks I afterwards made a Rod, which together with the Tube, was somewhat more than eighteen Feet long, which was the greatest Length I could conveniently use in my Chamber, and found the Attraction very nearly, if not altogether as strong, as when the Ball was placed on shorter Rods.

*May* 14 1729, between six and seven o'Clock in the Evening. Having provided a Rod of about-twenty four Feet, that consisted of a Fir-Pole, of Cane, and the Top of Reed, upon the End of which the Ball of Cork was placed, and the great End of the Rod put into the Tube about seven or eight Inches; then the Leaf-Brass being laid down, and the Tube rubbed, the Ball attracted and repelled the Leaf-Brass with Vigour; so that it was not at all to be doubted, but with a longer Pole the Electricity would have been carried much farther.

*May* the 16th, I made a Rod thirty-two Feet long, including the Tube; the bigger Part of it was a Fir-Staff about six Feet and a half long, the rest was of Cane, and Reed for the top Part of it. All Things being prepared, as before, the Effect was the same as in the last Experiment, only the Pole bending so much, and vibrating by rubbing the Tube, made it more troublesome to manage the Experiment. This put me upon making the following Experiments.

*May* the 19th, about six in the Morning, the Ivory Ball being suspended on the Tube, by a Line of Packthread twenty-six Feet long, which was the Height, I stood at in the Balcony, from the Court where he stood, that held the Board with the Leaf-Brass on it; then the Tube being rubbed, attracted the Leaf-Brass to the Height of near two Inches, as he that assisted informed me. This was repeated with the Cork Ball with the same Success.

*May* the 31st, in the Morning, to a Pole of eighteen Feet there was tied a Line of thirty-four Feet in Length; so that the Pole and Line together were fifty-two Feet. With the Pole and Tube I stood in the Balcony, the Assistant below in the Court, where he held the Board with the Leaf-Brass on it; then the Tube being excited as usual, the Electric Virtue passed from the Tube up the Pole, and



### *More Experiments concerning Electricity.*

down the Line to the Ivory Ball, which attracted the Leaf-Brafs, and as the Ball passed over it in it's Vibrations, the Leaf-Brafs would follow it, till it was carried off the Board: But these Experiments are difficult to make in the open Air, the least Wind that is stirring, carrying away the Leaf-Brafs.

Some Time after I made several Attempts to carry the Electric Virtue in a Line horizontally, since I had not the Opportunity here of carrying it from greater Heights perpendicularly, but without Success, for want of then making use of proper Materials, as will appear from what follows. The first Method I made Trial of, was by making a Loop at each End of a Line, and hanging it on a Nail driven into a Beam, the other End hanging downwards, through the Loop at this End the Line with the Ivory Ball was put; the other End of this Line was by a Loop hung on the Tube; so that that Part of the Line next the Ball hung perpendicular, the rest of the Line Horizontal: Then the Leaf-Brafs being laid under the Ball, and the Tube rubbed, not the least Sign of Attraction was perceived. Upon this I concluded, that when the Electric Virtue came to the Loop that was suspended on the Beam, it went up the same to the Beam; so that none, or very little of it at least, came down to the Ball, which was afterwards verified, as will appear by the Experiments that will be mentioned hereafter.

June the 30th, 1729, I went to *Otterden-Place*, to wait on Mr *Wheler*, designing only to give him a Specimen of my Experiments. The first was from the Window in the Long Gallery that opened into the Hall, the Height about sixteen Feet; the next from the Battlements of the House down into the fore Court, twenty-nine Feet; then from the Clock-Turret to the Ground, which was thirty-four Feet, this being the greatest Height we could come at; and notwithstanding the Smallness of the Cane, the Leaf-Brafs was attracted and repelled beyond what I expected. As we had no greater Heights here, Mr *Wheler* was desirous to try whether we could not carry the Electric Virtue horizontally. I then told him of the Attempt I had made with that Design, but without Success, telling him the Method and Materials made use of, as mentioned above. He then proposed a Silk Line to support the Line, by which the Electric Virtue was to pass. I told him it might do better upon the Account of it's Smallness; so that there would be less Virtue carried from the Line of Communication, with which, together with the apt Method Mr *Wheler* contrived, and with the great Pains he took himself, and the Assistance of his Servants, we succeeded far beyond our Expectation.

The first Experiment was made in the matted Gallery July 2, 1729, about Ten in the Morning. About four Feet from the End of the Gallery there was a cross Line that was fixed by it's Ends to each Side of the Gallery by two Nails; the middle Part of the Line was Silk, the rest at each End Packthread; then the Line to which the Ivory Ball



### *More Experiments concerning Electricity.*

15

Ball was hung, and by which the Electric Virtue was to be conveyed to it from the Tube, being eighty Feet and a half in Length, was laid on the cross Silk Line, so as that the Ball hung about nine Feet below it. Then the other End of the Line was by a Loop suspended on the Glass Cane, and the Leaf-Brass held under the Ball on a Piece of white Paper; when the Tube being rubbed, the Ball attracted the Leaf-Brass, and kept it suspended on it for some Time.

This Experiment succeeding so well, and the Gallery not permitting us to go any farther in one Length, Mr *Wheler* thought of another Expedient, by which we might encrease the Length of our Line, which was by putting up another cross Line near the other End of the Gallery; and over the Silk Part of both the Lines there was laid a Line that was long enough to be returned to the other End, where the Ball hung; and though now both Ends of the Line were at the same End of the Gallery, yet Care was taken that the Tube was far enough off from having any Influence upon the Leaf-Brass, except what passed by the Line of Communication: Then the Cane being rubbed and the Leaf-Brass held under the Ivory Ball, the Electric Virtue passed by the Line of Communication to the other End of the Gallery, and returned back again to the Ivory Ball, which attracted the Leaf-Brass, and suspended it as before. The whole Length of the Line was 147 Feet.

We then thought of trying whether the Attraction would not be stronger without doubling or returning the Line, which we found Means of doing in the Barn, where we had a Line of 124 Feet long, fourteen Feet of which hung perpendicular from the Silk Line; and now the Attraction was, as we then concluded, stronger than when the Line was returned, as in the matted Gallery.

July 3, between Ten and Eleven in the Morning we went again into the Barn, and repeated the last mentioned Experiment with both the Tube and Cane; but the Attraction was not so strong as in the preceding Evening, nor was there so great a Difference in the Attraction communicated by the solid Cane and Glass Tube, as one would have expected, considering the Difference of their Lengths and Diameters.

We then proceeded farther, by adding so much more Line as would make a Return to the other End of the Barn, the whole Length of the Line being now 293 Feet; and though the Line was so much lengthened, we found no perceivable Difference in the Attraction, the Ball attracting as strongly as before. This encouraged us to add another Return; but upon beginning to rub the Tube, our Silk Lines broke being not strong enough to bear the Weight of the Line, when shaken by the Motion given it by rubbing the Tube. Upon this, having brought with me both Brass and Iron Wire, instead of the Silk we put up small Iron Wire; but this was too weak to bear the Weight of the Line. We then took Brass Wire of a somewhat larger Size than



than that of Iron. This supported our Line of Communication; but though the Tube was well rubbed, yet there was not the least Motion or Attraction given by the Ball, neither with the great Tube, which we made use of when we found the small solid Cane to be ineffectual: By which we were now convinced, that the Success we had before, depended upon the Lines that supported the Line of Communication, being Silk, and not upon their being small, as before Trial I imagined it might be; the same Effect happening here as it did when the Line that is to convey the Electric Virtue is supported by Packthread; *viz.* that when the Effluvia come to the Wire or Packthread that supports the Line, it passes by them to the Timber, to which each End of them is fixed, and so goes no farther forward in the Line that is to carry it to the Ivory Ball.

Finding that our Silk Threads were too weak to bear many Returns of Line, Mr *Wheler* thought of another Way of managing them, so that fewer Returns might be upon each Silk Line; which was by placing two other cross Lines some Feet below the upper ones; so that every other Turn of Line was suspended by the lower cross Line. By this Means there was but half the Weight of Line upon each Silk of what there was when only two cross Lines were made use of as before. By this Contrivance, we could add a much greater Length of Line, without Danger of breaking our Silk. We then put up a Line that was 666 Feet in Length, by eight Returns: Then the Leaf-Brass being held on a Piece of white Paper under the Ivory Ball, and the Tube, with the other End of the Line suspended on it, being rubbed for some time, the Leaf-Brass was attracted as manifestly as it had been with much shorter Lines. We then repeated the Experiment with the little short solid Cane, and found there was somewhat of an Attraction, but not near so great as with the large Tube.

Though the going and returning of the Electric Effluvia was very surprising, yet we were willing to try how far the attractive Virtue might be carried in a continued right Line; the Method of doing which was thus: That End of the Line where the Attraction was to be made, was suspended on a Silk Line that was fixed cross the Garret Window on the North-side of the House, which was by Estimation about forty Feet high; at about an hundred Feet from hence two Rods or Poles of about ten Feet long, and at two Feet distance from each other, were driven into the Ground, so as that they stood nearly perpendicular. These were in the great Garden, beyond these, in the great Field, that is separated from the Garden by a deep Foss, about the same Distance from the first, were another Pair of Poles fixed; then four others at a like Distance. Upon the Ends of these Poles were tied the cross Lines of Silk, to support the Line of Communication, which being laid on the Silk Lines, the Ivory Ball hanging in the Garret Window, and the other End of the Line being hung by a Loop on the Tube, the Leaf-Brass was held under the Ball, and after  
the



### *More Experiments concerning Electricity.*

the Tube had been rubbed for some Time, they called to me to let me know that there was an Attraction of the Leaf-Brafs. This was several Times repeated with Success; then Mr *Wheler* came into the Field, and rubbed the Tube himself, that I might see there was an Attraction; which I saw, though I perceived it not to be so strong as when the Attraction was carried by longer Line, by returning it, as in the Experiments abovementioned. The Length of the Line was 650 Feet. This was several Times repeated, but the Experiment being made in the Evening, at length the Dew began to fall. We began about seven o'Clock, or some little Time after, but before Eight the Attraction ceased: But whether this was caused by the Dew falling, or by my being very hot, we could not positively say, but I rather impute it to the latter. This Experiment was made *July 14, 1729.*

*Note,* That though we call the carrying the Electric Virtue by the Lines in this Position Horizontal, you are not to understand it in a strict Sense, as may be easily perceived by the Description of the Method; and That as the Line swagged down much below the Silk Lines that supported it, in the middle Part between those Lines, it was some Feet longer than the Distance of the Poles.

Some Days after this Experiment was repeated from the Turret Closet Window, when the Line was 765 Feet, and the Attraction was no less perceivable than in the Experiment abovementioned.

### *More Experiments made at Mr Wheler's, shewing that large Surfaces may be impregnated with Electric Effluvia.*

A large Map of the World, that had twenty-seven square Feet in it a Table-Cloth containing fifty-nine square Feet; these suspended on the Tube by Packthreads, became Electrical. An Umbrello, suspended by a Packthread tied to the Handle of it, became strongly Electrical.

### *An Experiment proposed by Mr Wheler, to see whether the Electric Virtue would be any Way hindered by the magnetical Effluvia of a Load-stone.*

This had a small Key hung by one of its arming Irons, and the Stone, together with the Key hung to it, were suspended on the Tube by a Packthread; then the Tube being rubbed, the Key and Stone both attracted the Leaf-Brafs, the Attraction being the same as that of other Bodies.



## *More Experiments concerning Electricity.*

*An Experiment made to shew that the Electric Virtue is carried several Ways at the same Time, and may be conveyed to considerable Distances.*

There were made three Stands, each composed of two upright Pieces of Fir, fixed perpendicular, near the Ends of a long square Board, distant from each other near a Foot and a half. Upon the Tops of these were tied Threads of Silk to support the Lines of Communication with the Tube and the attracting Bodies. One of these Stands was placed in the great Parlour, near the farther End; another in the little Parlour, and a third in the Hall, which was between the two Parlours: As the other two were one of them to the right, the other to the left Hand, this last was placed near the Hall-Window forwards; the two first were about fifty Feet, the other about twenty Feet from the Place where the Tube was held; then there were taken three small square Pieces of Wood, that were tied to three Lines of Packthread: These were of about the Lengths above-mentioned. They were laid on the Silk Lines, and by Loops at the other Ends were suspended on the Tube; then the Leaf-Brass being held under the Pieces of Wood, and the Tube rubbed, they all of them attracted the Leaf-Brass at the same Time. Some Time after, in my Absence, Mr *Wheler* tried a red hot Poker, and found that the Attraction was the same as when cold. He also suspended a live Chick upon the Tube, by the Legs, and found that the Breast of the Chick was strongly Electrical.

*At Mr Godfrey's I made the following Experiments; shewing that the Electric Virtue may be carried from the Tube, without touching the Line of Communication, by only being held near it.*

The first of these Experiments was made the 5th of *August*, 1729. I shall here mention some of the most considerable ones; but as I did not always set down the Day of the Month, some of them may not be related in the Order of Time they were made; nor did I always mention the Length of the Lines, these not being thought to be absolutely necessary.

I took a Piece of a Hair-Line, such as Linnen-Cloaths are dried on, of about eleven Feet in Length; which, by a Loop at the upper End of it, was suspended on a Nail, that was driven into one of the Rafters in the Garret, and had at it's lower End a leaden Weight of fourteen Pounds hung to it by an Iron Ring: then the Leaf-Brass was laid under the Weight, and the Tube rubbed, and being held near the Line without touching it, the Lead-Weight attracted and repelled the Leaf-Brass for several times together, to the Height of at least three, if not four Inches. If the Tube was held three or four Feet above the Weight, there would be an Attraction; but if it were held higher up, so as to be near the Rafter where the Weight was hung by the Hair-Line, there would be no Attraction.



*An Experiment, shewing that the Electric Virtue may be carried several Ways at the same Time, by a Line of Communication, without touching the said Line.*

There were taken two Hair-Lines, of between four and five Feet long; to each of these was tied a square Piece of Cork, by Packthread; the Lines were suspended by Loops at their upper Ends, upon two Nails; near the lower Ends there was tied to the Hair-Lines a Piece of Packthread, by which there was a Communication between the two Hair-Lines; then the Leaf-Brass being laid under the Corks, and the Tube being rubbed, and held near one of the Lines, both the Corks attracted; but that which was farthest, much stronger than that, near which the Tube was held. About the Middle of the Line of Communication they both drew with equal Force.

*Some Time after, at Mr Wheler's, we made the following Experiment, in order to try whether the Electric Attraction be proportional to the Quantity of Matter in Bodies.*

There were made two Cubes of Oak, of about six Inches square, the one solid, the other hollow: These were suspended by two Hair-Lines, nearly after the same Manner as in the Experiment abovementioned; the Distance of the Cubes from each other, was by Estimation, about fourteen or fifteen Feet; the Line of Communication being tied to each Hair-Line and the Leaf-Brass placed under the Cubes, the Tube was rubbed and held over the Middle of the Line, and as near as could be guessed, at equal Distances from the Cubes, when both of them attracted and repelled the Leaf-Brass at the same Time, and to the same Height; so that there seemed to be no more, Attraction in the solid than in the hollow Cube; yet I am apt to think that the Electric Effluvia pass through all the interior Parts of the solid Cube, though no Part but the Surface attracts; for from several Experiments it appears, that if any other Body touches that which attracts, it's Attraction ceases till that Body be removed, and the other be again excited by the Tube.

*A Continuation of the Experiments made at Mr Godfrey's.*

I next went on with an Experiment, to see if the Electric Virtue might not be conveyed to a Rod, without inserting it into the Bore of the Tube, or without touching the Rod, which I found to succeed, by suspending the Rod either by Lines of Silk, or by Pieces of Horse-Hair Fishing-Lines, placing a Ball of Cork on the lesser End of the Rod.

August 13, I took a large Pole that was twenty-seven Feet long, two Inches and a half Diameter at the great End, and at the lesser



## *More Experiments concerning Electricity.*

about half an Inch: It was that Sort of Wood they call Horse-Beech, with the Rind on. This was suspended by two Hair-Lines of about four Feet and a half in Length; the first Line was about two Feet from the great End of the Pole, the other about eight Feet from the lesser End; so that the pole hung horizontal. At the little End of the Pole was hung a Ball of Cork about an Inch and a half Diameter by a Packthread about a Foot long, and a small leaden Ball upon the Cork to keep the Packthread extended: Then the Leaf-Brass being laid under the Cork, the Tube rubbed and held near the great End of the Pole, the Cork Ball drew the Leaf-Brass strongly to the Height of an Inch, if not more: Then the Leaf-Brass being held under several Parts of the Pole, it was attracted by it, as Mr Godfrey observed, but not near so strongly as by the Cork.

*About the Beginning of September I made the following Experiment, which shews that the Electric Effluvia will be carried in a Circle, and be communicated from one Circle to another.*

There was taken a Hoop of about two Feet two Inches Diameter; this I suspended by a Hair-Line upon a Nail driven into a Beam; the Line was about four Feet long; then the Leaf-Brass being laid under the Hoop, the Tube was rubbed, and held within the Hoop, near the upper Side of it, without touching it by several Inches: Then the lower Part of the Hoop attracted and repelled the Leaf-Brass strongly; but when held near the lower Part, there was very little, if any Attraction. If the Tube was held near the outside of the Hoop, it attracted; but strongest, when at the same Time it was held near the Knot of the Hair-Line by which the Hoop was suspended. To this Hoop there was tied a lesser Hoop of about a Foot and a half Diameter: It was tied to it by Packthread, so as to hang below it about two Inches. They were suspended together by the Hair-Line; then the Leaf-Brass and the Tube being prepared, as hath been mentioned before, the Tube being held near the upper Hoop, the lower Part of the lower Hoop attracted strongly, and when held near the upper Part of the lower Hoop, but very weakly. But when held near the lower Part of the lower Hoop, there was no Attraction.

*On the 15th of September I made the following Experiment which shews, that the Electric Effluvia have the same Effect in a Circle, when it's Position is horizontal.*

I took a large Hoop, of somewhat more than three Feet Diameter, and Breadth of about two Inches and a half; to this was tied at near equal Distances, four Lines: They were what they call Twine, which is of three Threads of Packthread twisted together each about two Feet eight Inches long. These were tied with their Ends together



to a Hair-line of about two Feet and a half long, by which the Hoop was hung on a Nail, as in the other Experiments, so that the Hoop hung now in an horizontal Position: Then the Leaf-Brafs being laid under the Edge of the Hoop, at between two and three Inches below it, the Tube being rubbed, and held between the Cords without touching them, the Leaf-Brafs was attracted and repelled for several times together; but when held near the outside of the Hoop, opposite to that Part where the Leaf-Brafs lay, the Attraction was much stronger.

About the latter End of Autumn, and the Beginning of the Winter in 1729, I resumed my Enquiry after other Electric Bodies, to see what Addition I could make to the Catalogue of those mentioned above, and found many more that have the same Property, and may be excited to attract by the same Method. As for Instance, the dry withered Leaves of Reeds and Flags, Grass and Corn, both Leaves and Straw; the Leaves of Trees, as those of the Laurel, the Oak, the Walnut, the Chesnut, Hazle-nut, Apple and Pear-tree Leaves; so that we may conclude, that the Leaves of all Vegetables have this Attractive Virtue.

*I shall now give an Account of the Experiments made at my Chamber in the Year 1730.*

*March* the 23d, I dissolved Soap in the *Thames*-Water, then I suspended a Tobacco-Pipe by a Hair-line, so as that it hung nearly horizontal, with the Mouth of the Bowl downwards; then having dipped it in the Soap-Liquor, and blown a Bubble, the Leaf-Brafs laid on a Stand under it, the Tube being rubbed, the Brafs was attracted by the Bubble, when the Tube was held near the Hair-line. Then I repeated the Experiment with another Bubble, holding the Tube near the little End of the Pipe, and the Attraction was now much greater, the Leaf-Brafs being attracted to the Height of near two Inches.

*March* the 25th, I repeated this Experiment after a somewhat different Manner: The Pipe was now suspended by two Lines of white sewing Silk, of about five Feet and a half long; these were hung upon two Nails driven into the Beam of my Chamber, distant from each other about a Foot, by Loops at the other End of the Lines, by which the Pipe was suspended; then the Bubble being blown, by holding the Tube to the little End of the Pipe, the Bubble attracted the Leaf-Brafs to the Height of near four Inches. This Experiment was made to see whether fluid Bodies would not have an Electricity communicated to them.

*April* 8, 1730, I made the following Experiment on a Boy between eight and nine Years of Age. His Weight, with his Cloaths on, was forty-seven Pounds ten Ounces. I suspended him in a horizontal Position, by two Hair-Lines, such as Cloaths are dried on: They were about thirteen Feet long, with Loops at each End.



There was driven into the Beam of my Chamber, which was a Foot thick, a Pair of Hooks opposite to each other, and two Feet from these another Pair in the same manner. Upon these Hooks the Lines were hung by their Loops, so as to be in the Manner of two Swings, the lower Parts hanging within about two Feet of the Floor of the Room: Then the Boy was laid on these Lines with his Face downwards, one of the Lines being put under his Breast, the other under his Thighs: Then the Leaf-Brass was laid on a Stand, which was a round Board of a Foot Diameter, with white Paper pasted on it, supported on a Pedestal of a Foot in Height, which I often made use of in other Experiments, though not till now mentioned: Upon the Tube's being rubbed, and held near his Feet, without touching them, the Leaf-Brass was attracted by the Boy's Face with much Vigour, so as to rise to the Height of eight, and sometimes ten Inches. I put a great many Pieces on the Board together, and almost all of them came up together at the same Time. Then the Boy was laid with his Face upwards, and the hind Part of his Head, which had short Hair on, attracted, but not at quite so great a Height as his Face did. Then the Leaf-Brass was placed under his Feet, his Shoes and Stockings being on, and the Tube held near his Head, his Feet attracted, but not altogether at so great a Height as his Head: Then the Leaf-Brass was again laid under his Head, and the Tube held over it, but there was then no Attraction, nor was there any when the Leaf-Brass was laid under his Feet, and the Tube held over them.

*April* the 16th, I repeated the Experiment with the Boy, but now the Attraction was not quite so strong as at the first, the Brass not rising higher than to about six Inches. His Hands being stretched nearly horizontal, I placed a small Stand with Leaf-Brass under each Hand, and under his Face the great one, furnished as the others; when the excited Tube being held near his Feet, there was an Attraction by his Hands and Face at the same Time. I then gave him the Top of a Fishing-Rod to hold in his Hand; there was a Ball of Cork stuck on the little End of it, under which the Leaf-Brass being laid, and the Tube rubbed and held near his Feet, the Ball attracted the Leaf-Brass to the Height of two Inches, and repelled it, and attracted for several Times together with great Vigour.

*April* 21, I again repeated the Experiment on the Boy; and now he attracted much stronger than at the first: The Leaf-Brass rose to his Face at the Height of more than twelve Inches. Then I gave the Boy to hold in each Hand the Tops of two Fishing-Rods, with a Ball of Cork on each of their lesser Ends; then a small Stand being set under each Ball, with the Leaf-Brass on it, the Tube being rubbed and held near his Feet, both the Corks attracted and repelled together strongly. The Length of the Poles were each of them about seven Feet. Then the Boy was laid on his left Side, and a Fishing-Rod, of near twelve Feet in Length, given him to hold with both his Hands

there



there was a small Ball of Cork at the End of the Rod, that was an Inch and three quarters Diameter: Then all Things being prepared, the Tube held near the Boy's Feet, the Cork Ball attracted and repelled the Leaf-Brass with Force to the Height of at least two Inches.

*Note,* That when I speak of holding the Tube near the Boy's Feet, I mean over against the Soles of his Feet; and when near his Head, is to be understood the Crown of his Head for when the Tube is held above, or over his Legs, the Attraction is not so strongly communicated to the other Parts of his Body.

By these Experiments we see that Animals receive a greater Quantity of Electric Effluvia, and that they may be conveyed from them several Ways at the same Time to considerable Distances, wherever they meet with a Passage proper for their Conveyance, and there exert their Attracting Power.

In these Experiments, besides the large Stand abovementioned, I made use of two small ones, which, as I found them very useful, it may not be improper to describe them. The Tops of them were three Inches Diameter; they were supported by a Column of about a Foot in Height, their Bases of about four Inches and a half: They were turned of *Lignum vitæ*; their Tops and Bases made to skrew on for Convenience of Carriage. Upon the Tops were pasted white Paper. When the Leaf-Brass is laid on any of these Stands, I find it is attracted to a much greater Height than when laid on a Table, and at least three Times higher than when laid on the Floor of a Room.

*June 20, I made the following Experiment, shewing that the Attraction and Repulsion is as strong, if not stronger, and that the Effluvia may be carried to great Lengths, without touching the Line by the Tube.*

There was taken a Line of Packthread 231 Feet in Length; it was supported on two cross Lines of blue Silk; the Distance of these Lines was near eighteen Feet. About four Feet below one of these Lines, was put up another Silk Line of the same Colour: To this was tied one End of the Packthread; at the other End the Ivory Ball hung; the Line was returned over the cross Lines thirteen times; then the Leaf-Brass being laid under the Ball, upon one of the small Stands and the Tube excited, the Ball attracted and repelled to the Height of one of it's Diameters, which was about an Inch and a quarter.

I have, by several Trials lately made, found that rubbing the Tube and putting it up between the Returns of the Line in several Places, before I go with the Tube to the End of the Line, much facilitates, and causes the Attraction much sooner than when one stands with the Tube and applies it to the End of the Line only.

*August 1, at Mr Wheler's, we made the following Experiment; being an Attempt to see how far the Electric Virtue might be carried forward in a Line, without touching the same.*

*This*



This Experiment was made by carrying the Line out of the Great Parlour Window into the Garden, and down the great Field before it. The Line was supported by fifteen Pair of Poles; each Pair had a Line of blue Silk tied from one Pole to the other, the Length of about four Feet, equal to the Distance of the two Poles: About ten Feet from the Window there was a Silk Line put up cross the Room upon which that Part of the Line hung that had the Ivory Ball upon it. Below the cross Line of the farthest Pair of Poles was placed another cross Line, four Feet from the Ground, to which was fastened the other End of the Communicating Line, as mentioned in the Experiment above: Then the Leaf-Brass and Tube being prepared as usual, the Tube being held over the Line at several Distances, beginning towards that End where the Ball hung, and so proceeding towards the farther End of the Line, the Leaf-Brass was attracted at the Stations not exceeding two or three hundred Feet, pretty strongly; but still grew weaker as we came towards the farther End of the Line: Yet even at the End of the Line, the Leaf-Brass would be lifted by the Ball, when the Tube touched the Line, whose Length was 886 Feet.

I should now have given some Account of the Discovery I made the last Year concerning the Attraction of coloured Bodies, shewing that they attract more or less, according to what Colours they are of, though the substance be the same, and of equal Weight and Bigness; only I shall observe, that I find the Red, Orange or Yellow, attract at least three or four times stronger than Green, Blue or Purple: But having very lately found out a new and more accurate Method of making these Experiments, I must beg Leave to proceed farther with them, before I communicate them.

Concerning the  
Electricity of  
Water, by the  
same. No 422.  
p. 227.

3. *First*, In the former Account of my Experiments, I described the manner of communicating an Attraction to a Bubble of soaped Water; but I have now found, that even a *Body of Water receives an Attractive Virtue, and also a Repelling one, by applying the excited Tube near it, after the same manner as solid Bodies do.* To perform this Experiment, I caused a wooden Dish to be turned, with a Screw-hole at the Bottom, but not so far as to come through the Wood: This was screwed on to the upper End of one of the Stands I have mentioned in the other Experiments, the other Top being taken off: The Dish was about four Inches Diameter, and one Inch deep. Then the Stand was set on a Cake of Rosin, or a Plate of Glass, or the Brims of a Drinking-Glass, or of a Cylicindric one, such as are used for Water Glasses. the Glass must be first warmed, then the Dish being filled with Water, the Tube rubbed, and moved both under the Dish and over the Water three or four times, without touching them. After it has been excited, not only the Dish, but the Water also, becomes Electrical; and if a small Piece of Thread, or a narrow Slip of thin Paper, or a Piece of Sheet-Brass, commonly called Tinsel, be held over the Water in an horizontal Position, within about an Inch or some-



sometimes more, any of the said Bodies will be attracted to the Surface of the Water, and be repelled, but not so often as by Solids. If a pendulous Thread be held at some Distance from the outside of the Dish, it will be attracted and repelled by it many times together with a very quick Motion, but not at so great a Distance as when the Dish is empty.

II. *An Experiment shewing, that Water is attracted by the Tube, and that the Attraction is attended with several remarkable and surprising Phænomena.*

This Experiment being to be made with small Quantities of Water, I at first made use of some of the Brass Concave little Dishes in which I formerly ground Microscopes; but have since caused to be made a more convenient Apparatus, which consists of a small Pedestal of about four Inches and a half long, the Base of Ivory about two Inches Diameter. Upon the upper End, as in the larger Stand, there is a Screw, upon which is screwed on one of the little Dishes, which are made of Ivory: Of these I have several Sizes, from three Quarters to one Tenth of an Inch Diameter. When any one of these little Vessels is filled with Water, so as that it may stand above the Brims of the Cup, and has acquired a Spherical Surface (as it will do in the smallest Cups) let it be set on the Table with the little Stand to which it had before been screwed, or which is better, upon the large Stand mention'd above, the great Dish being taken off, and the small plain Top screwed on; being thus prepared, let the Tube be excited, and held over the Water at the Distance of about an Inch or more. If it be a large Tube, there will first arise a little Mountain of Water from the Top of the Drop, of a conical Form, from the Vertex of which there proceeds a Light (very visible when the Experiment is performed in a dark Room) and a snapping Noise, almost like that when the Fingers are held near the Tube, but not quite so loud, and of a more flat Sound: Upon this immediately the Mountain, if I may so call it, falls into the rest of the Water, and puts it into a tremulous and waving Motion. I have now a few Days since repeated this Experiment in the Day-time, where the Sun shined: I perceived that there were small Particles of Water thrown out of the Top of the Mount, and that sometimes there would arise a very fine Stream of Water from the Vertex of the Cone, in the manner of a Fountain, from which there issued a fine Stream, or Vapour, whose Particles were so small as not to be seen; yet it is certain that it must be so, since the under Side of the Tube was wet, as I found when I came to rub the Tube again; and I have since found, that though there does not always arise that Cylinder of Water, yet there is always a Steam of invisible Particles thrown on the Tube, and sometimes to that Degree as to be visible on it. When some of the larger Cups are made use of they



they are to be filled as high as may be without running over: The Surface will be flat about the middle Part, but when the Tube is held over it, the middle Part will be depressed into a Concave, and the Parts towards the Edge be raised; and when the Tube is held over against the Side of the Water, the little conical Protuberance of Water issues out with its Axis horizontally, and after the crackling Noise, returns to the rest of the Water, and sometimes there will be thrown out of it small Particles of the same, as from the smaller Portions of Water abovementioned.

The last Experiment was repeated with hot Water; when the Water was attracted much stronger, and at a much greater Distance: The Steam arising from the Vertex was in this Case visible, and the Tube was sprinkled with large Drops of Water. I tried the Experiment in the same Manner upon Quicksilver, which was likewise raised up; but by reason of it's great Weight, not to so great an Height as the Water: The snapping Noise was louder, and lasted much longer than in the Water.

*Farther Experiments concerning Electricity, by the same. No 423. p. 285.*

4. Since my last wherein I gave an Account of my Experiments, shewing Water will be attracted by Electric Bodies, and that it may have an Electric Virtue communicated to it, so as to attract solid ones, I have been upon another Enquiry; Whether there might not be a Way found to make this Property of Electrical Attraction more permanent in Bodies? How far I have succeeded in this Attempt, will appear by the Experiments I have made on the several Bodies mentioned in the following Catalogue; and as they were all of them prepared after the same manner, excepting Numb. 18 and 19, which shall be described afterwards, a general Description of the Method of preparing and preserving them in a State of Attraction, may suffice.

The Bodies on which the Experiments were made, were Rosin both black and white, Stone-Pitch, Shell or Gum-Lac, Bees-Wax, and Sulphur. I procured three Iron Ladles of several Sizes, in which I melted these Substances, making use of that which I thought most convenient for the Quantity I designed to melt. When any of these Bodies were melted, they were taken off the Fire, and set by in the Ladle to cool and harden; then it was returned to the Fire, where it remained till it was melted about the Bottom and Sides of the Ladle, so as to be moveable; so that by inverting the Ladle, it might be taken out; having the Form of nearly the Section of a Sphere, the Convex Surface, as also the Plain one, being naturally (if I may so say) polished, excepting the Sulphur, which cools without retaining its Polish, except when cast in Glass Vessels, as shall be shewed hereafter. I shall now proceed to the Experiments and Observations made on these Electric Bodies.

When any of them were taken out of the Ladle, and their Convex Surface hardened, they would not at first attract, 'till the Heat was abated,



abated, or 'till they came to a certain Degree of Warmth, and then there was a small Attraction which Warmth I estimated to be nearly that of a Hen's Egg when just laid: The Attraction encreasing so, as when cold, to attract at least ten times farther than at first.

The manner of preserving them in a State of Attraction, was by wrapping them up in any thing that would keep them from the external Air; as at first for the smaller Bodies I used white Paper, but for the larger ones white Flannel; but afterwards found that black Worsted Stockings would do as well. Being thus cloathed, they were put into a large Fir Box, there to remain 'till I had Occasion to make use of them.

The Cylinder of Sulphur, *Numb.* 18, was made by melting the Sulphur, and pouring it into a Cylandric Glass Vessel, which had first been heated, to prevent it's cracking. When the Sulphur was hardened, it was somewhat less than the Glass; so that by inverting the Glass, it came out easily, and had a polished Surface almost as smooth as the Glass in which it was cast. The large Cone of Sulphur, *Numb.* 19, was made after the same manner; viz. by being cast in a large Drinking-Glass.

I am now to give an Account of the Observations made on the several Bodies mentioned in the Catalogue, but must first give a Description of the Catalogue. The first Column contains the Number, which in a small Piece of Paper is fixed on each of the several Bodies; the Name of which is given in the second Column, whether they are single or compound Substances. The third Column shews what Weight they were of when melted, in Ounces and Drachms of *Averdupois* Weight. In the fourth Column you have the Days of the Month when the Body was melted and received it's Form, and consequently when it first began to attract.

I did for thirty Days continue to observe every one of these Bodies, and found that at the End of the said Time they attracted as vigorously as at the first or second Day, as they do now at the writing hereof. By the Times mentioned in the Catalogue, being subtracted from any Time after, will be shewn how long any of the Bodies have continued their Attractive Virtue; by which it will appear, that some of them have not lost their Attraction for more than four Months: So that we have some Reason to believe, that we have now discovered that there is a *perpetual attractive Power* in all Electric Bodies, without exciting by either rubbing, heating, &c. or any other Attrition. But this will farther appear by the Account I am now to give of the two last Bodies mentioned in the Catalogue. The Cone of Sulphur, *Numb.* 19, that was cast in a large Drinking-Glass, in about two Hours after it was taken out of the Glass, attracted, and the Glass attracted too, but at a small Distance. Next Day the Sulphur was taken out of the Glass, and then it attracted strongly, but there was now no perceivable Attraction of the Glass. Then the Cone of Sulphur was set with it's Base upon the Lid of the Fir Box, wherein the other Electric Bo-



dies lay, and the Glas whelmed over it. I examined it every Day, after, and still found it to attract; but finding the Place not so convenient, having Occasion to look into the Box often, I removed it to the Table that stands between the two Windows of my Chamber, where it has continued to this Time, and whenever the Glas is taken off, attracts at near as great a Distance as the Sulphur that is clothed and shut up in the Box abovementioned. And though at first there was no Attraction, when the Glas was taken off, yet I now find, that in fair Weather the Glas also attracts, but not at so great a Distance as the Sulphur, which never fails to attract, let the Wind or Weather be never so variable, as do all the other Bodies mentioned in the Catalogue; only in wet Weather the Attractions are not made at so great a Distance as in fair Weather.

Number 20 is a Cake of Sulphur that was melted; and as the other Bodies have taken the Form of a Convex Section of a Sphere, this when cold, was laid with it's flat Side downwards, on the same Table with the Cone of Sulphur: They were both placed so near the Wall, as to prevent the Sun shining on them. This was, as the Catalogue shews, on the 18th of *April*; and, though it had no manner of Clothing or Covering, has attracted ever since. And in this, as in the other Bodies, the Attraction will be according to the Weather; but when it attracts the strongest, it is not more than the tenth Part of what the Cone of Sulphur, that is covered, attracts.

The manner of observing these Attractions is best performed by holding the Attracting Body in one Hand, and a fine white Thread tied to the End of a Stick, in the other; by this means far less Degrees of Attraction will be perceived, than by making use of Leaf-Brafs. When the Thread is held at the utmost Distance, it may be attracted; the Motion of it is at first very slow, but still accelerating as it approaches nearer to the attracting Body.

I am now on the Subject of permanent Attraction in Glafs, than in the other Bodies, but have not yet compleated those Experiments, meeting with more Interruption by the Weather.

With a small Hand Air-Pump, I have made Experiments on several Bodies, and find that they will attract *in vacuo*, and that at very nearly the same Distance as *in pleno*, provided that the Experiment be made in the same Receiver filled with Air; as will appear by the following Experiments.

There was taken a hollow Glas Sphere, of somewhat more than  $2\frac{1}{2}$  Inches Diameter, being first excited. It was suspended by a Loop of Silk that went through a small Cork, with which the Hole in the Glas Ball, by which it was blown, was stopped, and by the Loop suspended on a small Hook that was skrewed on to the Brass Wire that came through the Collar of Leather in the Brass-Plate that covered the Top of the open Receiver; as in the Experiment of letting fall the Guinea and Feather *in vacuo*. Then the Ball was drawn up to the  
Top



Top of the Receiver, and the Top of the small Stand, covered with Paper, was laid on the wet Leather on the Plate of the Pump, and Leaf-Brass laid on the same. Then the Air was exhausted, when the Glass Ball was let down to about an Inch, or somewhat more, towards the Pieces of Leaf-Brass: Many of them were attracted by it. Then the Air was let into the Receiver, and the Leaf-Brass laid on the Stand, the Ball being, as before, suspended, was let down to about the same Distance from the Leaf-Brass as before, and there seemed to be very little Difference in the Attraction.

I have made the same Experiments with Sulphur, Shell-Lac, Rosin, and white Bees-Wax. These would be attracted to the Height of an Inch and a half by Estimation; and when the Experiment was made with the Receiver full of Air, there was very little, if any Difference in the Height of the Attraction, when there was the same Time spent before the Attraction was begun *in pleno*, as there was required to exhaust the Receiver.

*A CATALOGUE of the several Electric Bodies mentioned in the foregoing Discourse.*

No	Names of the several Bodies.	Weight.		Months.	Days.
		3	3		
1	Fine black Rosin — — — —	2	0	January	31
2	Stone Pitch and black Rosin — —	2	2	January	31
3	Fine Rosin and Bees-Wax — — — —	2	1	February	1
4	Stone Pitch — — — — —	1	7	February	1
5	Stone Sulphur — — — — —	3	6	February	4
6	Shell-Lac — — — — —	10	0	February	10
7	Fine black Rosin — — — — —	10	4	February	11
8	Bees-Wax and Rosin — — — — —	9	0	February	12
9	Rosin 4 parts, and Gum-Lac 1 part	10	0	February	12
10	Sulphur — — — — —	18	0	February	15
11	Stone Pitch — — — — —	10	12	February	16
12	Black Rosin — — — — —	23	0	February	23
13	White Rosin — — — — —	7	12	February	25
14	Gum-Lac — — — — —	11	14	February	26
15	Gum-Lac and black Rosin ana — —	9	12	February	26
16	Gum-Lac 4 parts, Rosin 1 part — —	17	8	February	28
17	Shell-Lac, fine black Rosin ana — —	28	4	March	2
18	A Cylinder of Stone Sulphur — —	19	4	March	20
19	A large Cone of Stone Sulphur — —	30	0	March	29
20	A Cake of Sulphur — — — — —	11	4	April	29



*A new Barometer, by Dan. Gab. Fahrenheit. F. R. S. N<sup>o</sup>. 385. p. 179.*

*Fig. 1.*

IV. Cylindro AB annectitur tubus BC, cui additur globulus oblongus CD, & huic tubulus gracillimo foramine præditus DE. Cylindrus liquore quodam, qui calorem aquæ ebullientis perferre potest, replebitur. In tubulo BC, gradus caloris in aëre obvii mensurabuntur ope scalæ affixæ *b c*. Si autem thermometrum hocce aquæ bullienti imponatur, liquor thermometri non solum globulum CD implebit, sed etiam usque ad terminos varios tubuli DE assurget, secundum gradum caloris, quem aqua tempore experimenti a gravitate atmosphæræ acquisitura est. Ita, si, exempli gratia, tempore experimenti altitudo mercurii in barometro sit 28 pollicum Londinensium, liquor in hocce thermometro attinget infimum locum in tubulo DE; Si vero gravitas atmosphæræ æquipolleat altitudini mercurii triginta & unius pollicum, liquor a calore aquæ ebullientis usque ad locum supremum tubuli DE attolletur, termini varii autem caloris aquæ ebullientis non gradibus, sed illorum loco numeris digitorum, quibus altitudo mercurii in barometris vulgo mensuratur, ope nempe scalæ additæ *d e* denotabuntur.

*Observations of an extraordinary Height of the Barometer, by Mr George Graham, F. R. S. N<sup>o</sup>. 369. p. 222.*

V. Upon *Thursday* the 21<sup>st</sup> of *December* 1721, observing the Barometer much higher than usual; that Evening, between Seven and Eight a Clock, I fill'd a Tube with very clean Quick-silver, and found the Height a little to exceed 30,7  $\frac{1}{2}$  Inches. By Eight the next Morning, a Wheel-Barometer, which hung in the same Room, had risen One tenth of an Inch higher than it was the Night before, when the Experiment was made; at Ten a Clock, One fifth of an Inch more: At which Time it was at the highest, being a little above 30,8  $\frac{1}{2}$  Inches; for about Twelve at Noon it was sensibly lower, and continued falling all the rest of the Day.

When the lower End of the Tube was first immers'd in the Cistern, the Quick-silver for some Time adher'd to the Crown of the Glass, but upon shaking, it fell to the Height abovemention'd.

*A Proposal for measuring the Height of Places, by help of Mr Patrick's Barometer, in which the Scale is greatly enlarged, by Edm. Halley, L. L. D. Astr. Reg. F. R. S. N<sup>o</sup>. 366. p. 116.*

VI. Since *Torricelli* first found the Mercury in an inverted Tube was in *æquilibrio* with the whole Column of Air that was over it; and that the Weight of the incumbent Column was various, according to the different Dispositions of the Air, in respect of serene fair Weather, and of rainy, windy, or otherwise tempestuous Weather: there have been several Attempts and Contrivances to make the minute Variations thereof more sensible. And first the Wheel-Barometer was thought of, which certainly shews these Variations with great exactness, but is only proper for a fixt station, and not easy to be removed; which Circumstance is required for the principal use to which this Instrument is applicable and for which I would recommend it.

The next Thought for this purpose was that of Mr *Hubin*, described in *Phil. Trans.* N<sup>o</sup> 184, who returning the Tube of the Barometer, as an inverted Syphon, made a large dilatation in the ascending leg thereof, wherein the Mercury ascended, as it's Altitude in the other part thereof abated, and *è contra*, over this he drew out a narrow Glass



Glass Cane, which he filled with a tinged Spirit, and which being about fifteen times lighter than *Mercury*, would ascend about 15 times as much as the *Mercury* in the Barometer fell. This, besides that the Spirit would dilate and contract itself with Heat and Cold, had the inconvenience of the former, not to be easily removed without great danger of disorder and breaking, by reason of the smallness of the Tube in which the Spirit was to rise and fall.

This was succeeded by Dr *Hook's* Marine Barometer, made of two Thermometers, the one the common seal'd weather Glass, having no communication with the outward Air, wherein the temper as to heat and cold was shewn by the swelling or shrinking of the included Spirit; the other the old Thermometer made with an inverted Bolt-head, in whose globular Part was included Air somewhat rarer than the ambient, so as to make the Liquor which was to rise and fall in the shank of the Bolt-head, always to stand above the surface of the *Stagnum*, into which it's end was immersed. This shew'd the heat of the Air by it's own dilatation; but at the same time, the different pressure of the Atmosphere mixed with it, so that the graduation of these two Thermometers be adjusted to any given Height of the *Mercury*, they would at all times when the *Mercury* was at that Height, both shew the same degree of Heat: But at other times when the weight of the Air was different, that difference would shew itself by the disagreement of the degree of Heat shewed by them. This will be better understood from N<sup>o</sup> 269, of the *Transactions*, wherein I have described this Instrument at large. This, tho' of admirable use at Sea, to give timely notice of approaching bad Weather, labours under the Objection that it supposes the Concave of the Tubes of the Thermometers to be Cylinders, or of equal Diameters throughout; and also that on account of Heat and Cold the Air and Spirit have a proportional Dilatation and Contraction; the first of which I take to be very hard to be found in ordinary Glass-Canes, and the other I fear still wants to be made out by authentic Experiments.

The last contrivance for this purpose is that of Mr *Patrick*, who styles himself the *Torricellian Operator*, by filling a small Glass-Cane about five foot-long, and somewhat, but as little as may be, tapering upwards toward the close end of the Cane; then inverting it, without a stagnant Cistern of *Mercury*, so much of the *Mercury* as exceeds the Length of the Column the Atmosphere can then support, will drop off, and leave it's length equal to the then present Height of the common Barometer: now when the Barometer rises, this length in the Cane becomes greater by the *Mercury's* being prest up into the upper and narrower Part of the Tube; and when it falls, on the contrary, it settles down into the wider part thereof, and becomes shorter, being always the same in quantity. By this means, as the Angle of the Concave Cone of Glass, of which this Tube consists, is smaller, the different Situation of the *Mercury*, will, upon the



the Alteration of the Air's pressure be nicely shewn by very large and distinct Divisions.

Now the Use to which I would apply this contrivance of the Barometer, is to measure by it the different Levels of Places too remote to be come at by the ordinary Instruments for levelling, with the certainty one would desire. For this purpose let there be provided two small Glass-Canes, as near as can be similar, growing very little taper or smaller at the closed end, so that being inverted, the *Mercury* may be suspended in them at the Height it ought to have at the time of the Experiment. Let that Height be duly noted, and then ascending the Monument, or some such Edifice where the Ascent may be exactly measured, let the Scales annexed be divided into parts by the descent of the *Mercury* at every ten feet, in both the pendent Barometers, which I conceive may be so chosen as to make the Divisions very distinct and sensible. These thus prepared, when it is desired to take the Level of two distant places, let one of them be placed in the lower place, at the time when the *Mercury* has the same Height as when they were first inverted and graduated; and let the other be carried to the higher place, where it will be found to stand at that division which answers the Elevation of that place above the other, the which had before been found by measure in ascending the Monument. Thus may 90 foot Ascent, which makes but one tenth of an Inch of *Mercury*, be represented by two or three Inches, or a space capable of being divided into 90 parts: whereas, if the distance of the two places be 20 Miles, a Minute of a Degree is equal to above 30 foot; and by the usual Sights, whether Telescope or otherwise of your water Levels, I fear it will be very hard to convey a true Level without a greater Error than one Minute in the whole. This Proposal I humbly submit to the Examination of this Honourable Society.

*The Barometrical Method of measuring the Height of Mountains, with two new Tables shewing the Height of the Atmosphere at given Altitudes of Mercury. By J.G. Scheuchzer, M. D. R. S. S. No. 405. P. 537.*

VII. The Height of Mountains, and their Elevation above the Level of the Sea, hath been at all Times thought worthy the Attention of inquisitive Philosophers. We find in *Pliny* \*, that *Dicaearchus*, one of the old Geographers, a Disciple of *Aristotle*, and, as *Pliny* himself styles him, a Man of great Learning, had by particular Order of some Princes measured the Heights of several Mountains, and that the highest of them, Mount *Pelios* in *Thessalia*, was found by his Observations 1250 Paces high perpendicularly. *Cleomedes* also, a Grecian Astronomer and Geographer, who lived some time before our Saviour's Nativity, asserts †, that the highest Mountain cannot be above 15 Stadia, or 9375 Roman Feet high.

But *Plutarch* || fixes the perpendicular Height of the highest Mountains, as also the greatest Depth of the Sea, only to 10 Stadia, or 6250 Roman Feet. It will appear by the Sequel of this Paper, that

\* Hist. Nat. L. xi. c. 65.

† Cyclicæ Theor. Cap. x.

|| In vita Æmilij.



the Height of Mountains, as determined by these early Writers, doth not so very much deviate from Truth, as one would be apt to suspect from the infant State of Arts and Sciences in those Times. Particularly the 15 Stadia of *Cleomedes*, which make out 9375 *Roman*, or 10,214 *Paris Feet*, will be found by the following Observations to come very near the Height of the Mountains of *Switzerland*, which, although the highest of *Europe*, do not rise above 10,000 *Paris Feet* above the Level of the Sea; and it may seem surprizing, that subsequent Writers, even such as were otherwise deeply skill'd in mathematical Learning, have run them up to an extravagant, and altogether unnatural Height.

At first, it is not improbable, they went only upon bare Conjectures; but afterwards, when Geometry came to be more and more improved, Quadrants, Semicircles, and other Geometrical Instruments were call'd in Use, by the Means of which, and by a Trigonometrical Calculation, the Heights of Places could be determined in a more satisfactory Manner. And yet, however true the Principles be, upon which this Method is founded, however nice the Instruments, and however curious the Observer, the Method itself must be owned, and hath been found by undoubted Experiments, to fall far short of that Accuracy, which it seems to promise; and the more considerable the Heights are, the more uncertain it will be. For, in the first Place, as the State of the Air is very different in different Seasons and different Weather, it's Refraction also becomes thereby greatly altered, which occasions the Tops of Mountains to appear higher at some Times than they do at others, and at all Times higher than they actually are. But besides, there is another Inconveniency, of which whoever is acquainted with the true State of mountainous Countries, must needs be sensible, and that is the extream Difficulty of meeting at the Bottom of high Mountains with Plains large enough for a proper horizontal Stand, or Basis, to such a Triangle, as an accurate and knowing Observer would think satisfactory to determine a considerable Height, making even proper Allowances for the Air's Refraction.

Among the many Improvements in Natural Philosophy, which are owing to the Torricellian Tube, one of the most considerable Inventions of the last Century, it hath been thereby enriched with a new Method of measuring the respective Heights of Places, and their Elevation above the Level of the Sea; a Method, which, although it must be owned, that it hath not as yet, and perhaps, considering the Inconstancy of the Air, hardly ever will be brought to an absolute Degree of Certainty, is yet in many Respects preferable to the Trigonometrical one, as it hath also been found by Experience to come nearer the Truth, and leads us, by a new and singular Scale, from the very Horizon of the Sea to the Tops of the highest Mountains, a Distance far beyond the Reach of Geometrical Instruments. This



new Method is grounded upon that that essential Quality of the Air, it's Gravity or Pressure. As the Column of Mercury in the Barometer is counterpoised by a Column of Air of equal Weight, so whatever Causes will make the Air heavier or lighter, it's Pressure will be thereby increased, or lessened, and consequently the Mercury rise or fall. Again the Air is more or less condensed, or expanded, in Proportion to the Weight, or Force, which presses it: Hence it is, that in *England, Holland*, the maritime Provinces of *France*, and in general all those Countries which border upon the Sea, the Mercury stands highest, that the higher you remove from the Sea into the midland Countries, the lower the Mercury will descend, because the Air also becomes more rarified and lighter, and that upon the Tops of the highest Mountains it falls lowest, and these Heights of the Mercury in different Places are reciprocally, as the Expansions of the Air. From these Principles, supported by a competent Number of Observations, it hath been attempted by several learned Men, to derive proper Tables, whereby the Height of any Place may be determined, if the Height of the Barometer be given, or the Height of the Barometer determined from the given Altitude of the Place, and likewise the Expansions of the Air settled, as they answer to every Inch, or Part of an Inch, in the Barometer.

*M. Mariotte*, a celebrated Member of the *Royal Academy of Sciences* at *Paris*, was one of the first that laid down certain Rules for the Construction of such Tables, as might serve to determine both the Elevation of Places above the Level of the Sea from given Altitudes of Mercury, and the Heights of the Air, answering to every Line of Mercury in the Barometer, from 28'', where the Mercury was supposed to stand at a Medium near the Sea. The Principles he went upon, and the Method he followed, he discoursed of at large, in his *Second Essay de la Nature de l'Air*.

Some time after, in 1686, *Dr Halley* went about another Calculation, which he derived partly from Principles agreeing with those of *M. Mariotte*, partly from the specifick Weight of Air and Mercury, which were found by Experiments to be as 1 to 10,800; Air being to Water as 1 to 800, and Water to Mercury as 1 to  $13\frac{1}{2}$ , or very near it. If so, as the Column of Mercury in the Barometer is counterpoised by a Column of Air of equal Weight, a Cylinder of Air of 10,800 Inches or 900 Feet will be equal to one Inch of Mercury, and 90 Feet to  $\frac{1}{10}$  of an Inch, or  $75$  to  $\frac{1}{12}$  Part of it. The Height of the Air, as it answers to one Inch of Mercury, being thus determined, and the Expansions of the Air being reciprocally as the Heights of Mercury, *Dr Halley*, by the Help of the Hyperbola and its Asymptotes, calculated two Tables, one shewing the Altitude to given Heights of Mercury, the other the Heights of Mercury at given Altitudes. These Tables, the first that ever were calculated, together with the Doctor's whole Method of proceeding, and an ingenious



genious Attempt of his to discover the true Reason of the Rise and Fall of Mercury upon Change of Weather, were printed in the *Philosophical Transactions* \*, and the Tables themselves were very lately re-printed, with some Observations upon them, by Dr *Desaguliers* †.

In the Year 1703, when the *Meridian* Line, first begun by *M. Picard* in 1669, afterwards continued in 1683, was farther pursued, several Observations of this Kind were made, and the Heights of several considerable Mountains, particularly in the Southern Parts of *France*, determined as well by Trigonometrical as Barometrical Observations. Monsieur *Cassini* the Younger took that Opportunity to compare these Observations with the Rules laid down by *M. Mariotte* ‖, in order to one which, and conformable to the said Rules, he calculated two Tables, shewing the Height of the Atmosphere, as it answers to every Line of Mercury in the Barometer, the other determining the Height of the Atmosphere above the Level of the Sea at given Altitudes of Mercury. But having afterwards, upon Comparifon, found that the Observations made in 1703, did not in the main agree with the Rules of *M. Mariotte*, and that the Heights of Places, as they appeared by those Observations, exceeded, generally speaking, the Numbers resulting from the Tables made by him according to the said Rules, he thought it necessary to calculate two new ones, wherein indeed the Results are considerably greater than in the Tables framed according to the Rules of *M. Mariotte*; infomuch, that for Instance, a Place, where the Mercury falls to 22 Inches, rises above the Level of the Sea, according to *Mariotte*, 852 Toifes, or 5112 *Paris* Feet; and, according to *Cassini*, 1158 Toifes, or 6948 Feet, which makes a Difference of 1836 *Paris* Feet, or 306 Toifes. Dr *Desaguliers*, in his Dissertation concerning the Figure of the Earth \*\*, hath already shewn how far the Observations made by the Gentlemen, that drew the *Meridian* a-crofs the Kingdom of *France*, differ from each other; infomuch, that there are not two in nine, where the Number of Toifes, said to correspond to the Heights of the Barometer, agree together; and that consequently the Heights of Mountains, as determined by these Observations, are little to be depended on.

My Father, Dr *J. J. Scheuchzer*, in his Journies over the Mountains of *Switzerland*, at they were more particularly calculated for the Improvement of Natural Philosophy in it's several Branches, neglected no Opportunity, along with his other Observations, to make such Experiments with the Barometer, as might serve to illustrate the Qualities of the Air, to settle the respective Heights of Places, and particularly to shew, how much our Mountains rise, as well above the Level of the Sea, as above other neighbouring Mountains in *France*,

\* No. 181. pag. 106.

† Phil. Transact. No. 386.

‖ Memoires de l' Acad.

Royale, 1705. pag. 61. & seq.

\*\* Phil. Transf. No. 386. pag. 211.



*Italy, Spain, &c.* Many of these Observations are scattered up and down in his Writings, particularly his *Itinera Alpina*, and the several Parts of his *Natural History of Swisserland*, which last Work was published in *High German*. It would be too tedious to mention all the Experiments he made at different Times, and upon different Mountains. But my Design in this Paper requires me to be particular in one, which for the Height measured both with the Line and Barometer is, I believe, the most considerable that ever was made, and which enabled him more particularly to examine the two Tables made by *Cassini* the Younger, according to the Rules of *M. Mariotte*, and the Observations made by him and others, when the *Meridian Line* was perfected in 1703.

This curious Experiment was made in the Year 1709, at *Pfeffers*, a celebrated Mineral Water in the County of *Sargans*, at the Bottom and Top of a Mountain, which rises from a small Brook, called the *Taminna*, to the Height of 714 *Paris Feet*, as appeared by letting a Line drop down perpendicularly from a Tree at Top, full to the Bottom. At the Bottom of this Mountain, near the *Taminna*, the Mercury was by repeated Experiments observed at 25'', 9  $\frac{1}{3}$ ''', and at the Top it descended to 24'', 11  $\frac{1}{3}$ ''', so that it fell just 10 Lines, for 714 Feet, which gives about 71 *Paris Feet* for a Line, if the Heights answering to every Line were supposed to be equal.

I must here once for all desire the Reader to take Notice, that I have made use in this Paper of *Paris Measure*, namely; of Toises (°) Feet (') Inches (") and Lines ('''). Every Toise is reckoned at six Foot, the Foot is divided into twelve Inches, and the Inch into twelve Lines.

The Heights of the Barometer at the Bottom and Top of the Mountain being thus given, the Height of it should be, according to *M. Mariotte*, 116°, 0', 8'', 11''', or 696 *Paris Feet*, 8'', 11''', which falls 17', 3'', 1''', short of the true Height, and according to *Cassini* 153° 3', 8'', that is, 921 *Paris Feet*, 8'', which exceeds the true Height by 207 *Paris Feet*, 8 Inches; whereby it appears, that the Table made according to the Rules of *Mariotte* is much preferable to that of *Cassini* the Younger. The same was likewise confirmed by another Experiment made in *June* 1715, upon the Steeple of our Cathedral at *Zurich*. At the Foot of the Steeple the Barometer stood at 26'', 10''', and at the Top at 26'', 7  $\frac{1}{2}$ ''', and the Height of the Steeple was found by the Line of 241 *Paris Feet*, 4 Inches, which gives very near 69 *Paris Feet* for one Line. According to the Table of *Mariotte*, the Height of the Steeple should have been of 237 *Paris Feet*, according to *Cassini*, 265, and according to the new Calculation (of which by and by) made pursuant to the Experiments above, it comes to 243°, 16'', 2''', or about two Foot more than the true Height.

It appearing by the Experiments made at *Pfeffers*, that from 25'', 9  $\frac{1}{3}$ ''' the Barometer descends to 24'', 11  $\frac{1}{3}$ ''', that is, just 10 Lines, for



TABLES of the Height of the Atmosphere to given Altitudes of Mercury.

The Fall of <i>Mer-</i> cury in the Baro- meter.	The Height of the Atmo- sphere, as it answers to every Line in the Barome- ter, according to <i>Mariotte</i> .				According to <i>Cassini</i> .				According to Dr <i>Scheuch-</i> <i>zer</i> .				The Height of the Atmosphere above the Level of the Sea, accor- ding to <i>Mariotte</i> .				According to <i>Cassini</i> .				According to Dr <i>Scheuchzer</i> .				Height of the Mercu- ry in the Barome- ter.									
	°	'	"	'''	°	'	"	'''	°	'	"	'''	°	'	"	'''	°	'	"	'''	°	'	"	'''	°	'	"	'''	°	'	"	'''		
0	10	3	0	0	10	0	0	0	10	4	6	9	0	0	0	0	10	0	0	0	10	4	6	9	0	0	0	0	28	0	0	0	0	
1	10	3	2	3	10	1	2	1	10	4	9	2	10	3	2	3	10	1	3	1	10	5	1	3	1	10	3	2	3	11	0	0	0	0
2	10	3	4	6	10	2	4	6	10	4	11	5	21	0	6	9	20	3	0	3	10	6	1	8	7	10	3	4	4	10	1	0	0	0
3	10	3	6	10	10	3	6	10	10	5	1	1	31	4	1	7	31	0	0	4	10	6	1	9	10	3	5	5	9	10	2	0	0	
4	10	3	9	1	10	4	1	4	10	5	4	1	42	1	10	8	41	4	3	5	10	8	3	9	10	4	6	10	3	1	0	0	0	
5	10	4	1	4	10	5	4	9	10	5	6	11	52	5	10	0	52	3	3	6	11	5	4	3	10	5	7	10	4	0	0	0	0	
6	10	4	1	9	10	5	6	1	11	5	8	11	63	3	11	9	63	4	3	7	11	6	5	4	10	6	8	10	5	0	0	0	0	
7	10	4	4	1	10	6	1	1	11	6	1	3	74	0	3	10	74	0	4	8	11	7	6	5	10	7	9	10	6	0	0	0	0	
8	10	4	6	5	10	6	3	5	11	6	4	1	85	0	10	3	85	2	2	10	8	7	1	6	10	8	10	7	10	7	0	0	0	
9	10	4	8	10	10	6	5	10	11	6	6	10	95	5	7	6	95	5	5	7	9	1	3	1	10	9	11	10	8	0	0	0	0	
10	10	5	1	1	10	7	8	10	11	6	6	10	106	4	7	3	106	4	4	7	10	3	3	1	10	10	12	10	9	10	8	0	0	
11	10	5	1	7	10	7	10	2	11	6	8	11	117	3	7	10	117	3	3	7	10	3	10	1	10	11	13	10	10	9	10	9	0	
12	10	5	4	0	10	8	0	0	11	7	1	10	128	2	11	10	128	2	11	10	13	1	4	0	10	12	14	10	11	10	10	10	0	
13	10	5	6	5	10	8	2	1	11	7	4	4	139	2	6	3	139	2	6	3	11	3	1	3	10	13	15	10	12	10	11	10	0	
14	10	5	8	10	10	8	4	6	11	7	6	10	150	2	3	1	150	2	3	1	11	3	1	1	10	14	16	10	13	10	11	10	0	
15	10	5	11	1	10	9	1	1	11	7	6	10	161	2	2	5	161	2	2	2	11	5	5	1	10	15	17	10	14	10	12	10	0	
16	10	5	1	9	10	9	3	5	11	7	9	4	172	2	4	2	172	2	4	2	11	5	2	2	10	16	18	10	15	10	13	10	0	
17	10	5	4	1	10	9	5	0	11	7	11	2	183	2	8	5	183	2	8	5	11	5	2	2	10	17	19	10	16	10	14	10	0	
18	10	5	6	3	10	9	7	3	11	7	2	7	194	3	3	3	194	3	3	3	11	5	2	3	10	18	20	10	17	10	15	10	0	
19	10	5	9	9	10	10	0	0	11	8	4	1	205	4	0	0	205	4	0	0	11	5	2	3	10	19	21	10	18	10	16	10	0	
20	10	5	11	1	10	10	2	1	11	8	6	10	216	5	0	3	216	5	0	3	11	5	3	3	10	20	22	10	19	10	17	10	0	
21	10	5	1	4	10	10	4	6	11	8	8	11	228	0	2	7	228	0	2	7	11	5	3	3	10	21	24	10	20	10	18	10	0	
22	10	5	4	1	10	11	1	1	11	8	11	4	239	1	7	6	239	1	7	6	11	6	1	1	10	22	26	10	21	10	19	10	0	
23	10	5	6	4	10	11	3	5	11	8	11	4	250	3	3	1	250	3	3	1	11	6	1	1	10	23	27	10	22	10	20	10	0	
24	10	5	9	7	10	11	3	8	11	8	11	3	261	5	1	3	261	5	1	3	11	6	1	1	10	24	29	10	23	10	21	10	0	
25	10	5	11	1	10	11	3	9	11	8	11	3	273	1	2	0	273	1	2	0	11	6	1	1	10	25	30	10	24	10	22	10	0	
26	10	5	1	7	10	11	4	2	11	8	11	4	284	3	5	4	284	3	5	4	11	6	1	1	10	26	31	10	25	10	23	10	0	
27	10	5	4	1	10	11	4	5	11	8	11	4	295	5	11	4	295	5	11	4	11	6	1	1	10	27	33	10	26	10	24	10	0	
28	10	5	6	9	10	11	4	8	11	8	11	4	307	2	8	0	307	2	8	0	11	6	1	1	10	28	34	10	27	10	25	10	0	
29	10	5	9	1	10	11	4	1	11	8	11	4	318	5	7	4	318	5	7	4	11	6	1	1	10	29	36	10	28	10	26	10	0	
30	10	5	11	4	10	11	4	3	11	8	11	4	330	2	9	5	330	2	9	5	11	6	1	1	10	30	37	10	29	10	27	10	0	
31	10	5	1	7	10	11	5	1	11	8	11	5	342	0	2	3	342	0	2	3	11	6	1	1	10	31	39	10	30	10	28	10	0	
32	10	5	4	10	10	11	5	4	11	8																								



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100



for the Height of 714 Feet, and the Expansions of the Air being reciprocally as the Heights of Mercury, my Uncle, Dr *John Scheuchzer*, undertook, pursuant to these Principles, and the Properties of the Hyperbola, to calculate a new Table, after the following Method.

As the Difference of the Logarithms of the two given Heights of the Ba- rometer 25'' 9 $\frac{1}{3}$ ''' and 24'' 11 $\frac{1}{3}$ ''', that is 309 $\frac{1}{3}$ and 299 $\frac{1}{3}$ , or	Is to Foot,	So the Difference of the Logarithms of the Height of Mercury near the Sea, 28'' 1''' to any lesser Height, as for Instance 28'' 0''', that is 337 —336, or	To the Height of the Atmosphere above the Level of the Sea, as it answers to one Line of Mercury, is
---	-------------	--	--

928 — 898

142717

714

1011 — 1008

12906

64', 6'', 9'''

Thus the Height of the Atmosphere at 28'' appears to be of 10°, 4', 6'', 9''', but, according to *Mariotte*, it is only of 10°, 3', or 63 Feet, and *Cassini* supposes it only at 10°, or 60 Feet.

In like Manner the Height of the Atmosphere, from 28'', 0''', to 27'', 11''' is found to be 64', 9'', 2'''. According to the same Rule half the Height of the Atmosphere, that is, the Height of the Place, where the Mercury in the Barometer would descend to 14 Inches, appears to be, 15060', 3'', 0''', or 2510°, 0', 3'', 0'''. Still upon the same Principle the Mercury will descend to one Line at the Height of 133,397 *Paris* Feet above the Level of the Sea, which makes 22,232 Toises, 5 Feet, or 11 *Paris* Miles (at 2000 Toises the Mile) 232 Toises, 5 Foot. But as in order to determine the whole Height of the Atmosphere, the Logarithm of 1''' ought to be deducted from the Logarithm of 336''' or 28'' 0''', and as that Logarithm is 00000, it follows from thence, that beyond the Place, where the Mercury would descend to 1'', the Air is expanded into an Indefinite Space.

VIII. In a former Paper, I took Notice that *Dicæarchus* found Mount *Pelios* in *Thessalia*, to be 1250 Paces high, which make 6250 *Roman*, or 6822 *Paris* Feet, a Height which we may well pronounce too great even for the absolute Height of Mount *Pelios*, I mean it's Rise above the Level of the Sea. Conformable to the Determination of *Dicæarchus*, I mentioned, that *Plutarch* fixes the Height of the highest Mountains, and the greatest Depth of the Sea to 10 Stadia, and *Cleomedes* affirms, that they cannot exceed 16 Stadia. The celebrated *Galileus de Galileis* is one of the most modest among the modern

*Remarks on  
the Height of  
Mountains in  
general, and  
of those of  
Switzerland in  
particular, by  
the same.  
Nº. 406. p.  
577.*



*Remarks on the Height of Mountains, &c.*

Writers on this Head: For he says, \* that the highest Mountains do not rise above a Mile, or 8 Stadia, or 5000 old *Roman Vespasian* Feet, which make 5458 *Paris* Feet above the Level of the Sea, which we shall find by and by to agree pretty well with some of the highest Mountains in *France*, and may conjecture to do so with those in *Italy*. *Kepler* went rather too far † when he assigned the Mountains of *Rhætia* (thought the highest in *Switzerland*) a Height of 26 Stadia, or 10000 old *Roman Vespasian* Feet, which make 10916 *Paris* Feet. The Opinions of some other Antient and Modern Geographers and Mathematicians, will appear better by the Table annexed.

*A Table shewing the Height of Mountains according to several Antient and Modern Writers.*

	Stadia.	Old Rom Vespasian Feet.	Paris Feet.
<i>Strabo</i> (Lib. II. Geog.) says, that the highest Mountain, called by him <i>Petra Sogdiana</i> , is of - - - - -	30	18750	20468
<i>Pererius</i> (Lib. XII. in <i>Genesin</i> ) determines the highest Mountains to - - - - -	32	20000	21832
<i>Leo Bapt. Albertus</i> ( <i>Architeſt.</i> Lib. X. Cap. i.) to		22500	23661
<i>Ath. Kircher.</i> ( <i>Ars magn. luc. &amp; umbr.</i> P. II. Probl. 5.) brings them to - - - - -	43	26875	29337
<i>Fromond.</i> (Lib. I. Meteor. Cap. 2. Art. i.) - - -	64	40000	43664
<i>Gilbertus de magnete.</i> L. IV. C. i. - - - - -	128	80000	87328
<i>Pliny</i> (Lib. III. Cap. lxiv.) according to the Explanation of <i>Fortunius Licetus</i> ( <i>de Lunæ Luce subobscura</i> , Lib. II. p. 306.) to - - -	400	250000	272900
<i>Ricciolus</i> , <i>Geophr.</i> (Lib. VI.) is of Opinion, in Pursuance of what he imagines to have demonstrated of the Mountains <i>Athos</i> and <i>Caucasus</i> , that possibly there may be Mountains of - - - - -	512	320000	349312

Now, in Opposition to this Table, wherein the Heights must needs, upon first View, appear romantic and unnatural, let us consider the Height of such Mountains, as have been measured, either by Trigonometrical or Barometrical Observations.

In *England*, the Height of *Snowdon-hill*, one of the highest Mountains in *Wales*, was measured Trigonometrically, by Mr *J. Caswell* of *Oxford*, and found to be of 1240 Yards, or 3720 *English* Feet, which make 3488 *Paris* Feet. At the Top of this Mountain, the Mercury subsided to 25<sup>ll</sup> 6<sup>lll</sup>, which being reduced to *Paris* Measure, make just 24<sup>ll</sup>. Now in the Tables above, the Height of the Place where the Mercury subsides to 24<sup>ll</sup>, is, according to *Mariotte*, of 544

\* Nuntius Sidereus, p. 14. lib. I. pag. 26.

† Astronom. Optic. p. 129, 135, & Epitom. Astronom.



Toifes, two Foot, or 3266 Foot above the Level of the Sea, according to *Cassini*, 676 Toifes, or 4056 Feet, and according to my Uncle's Calculation 559<sup>o</sup> 2<sup>l</sup>, or 3356<sup>l</sup>, so that *Mariotte* comes 222 Feet short of it's Height, as it was determined Trigonometrically, Dr *Scheuchzer* but 132<sup>l</sup>, but *Cassini* exceeds this Height by 568 Feet, which confirms again, as I have shewn in a former Paper, that the *Mariottian* Table is preferable to that of *Cassini*, though pretended to have been corrected upon the former, and that that of Dr *Scheuchzer* is an Improvement upon both. According to the Observations made by Dr *Halley*, May 26, 1697, the Mercury stood at the Top of *Snowdon-hill*, at 26<sup>ll</sup> 1<sup>lll</sup> *English*, which, if reduced as above, would give the Height of the Mountain something less.

In *France*, when the Meridian Line, first begun in 1669, was continued in 1703, the Heights of several Mountains, particularly in the South of *France*, were determined Trigonometrically by the Members of the *Royal Academy of Sciences*: And I find up and down in their Memoirs, the Heights of the following.

	Height in	
	Toifes.	Feet.
<i>Mont Clairet</i> in <i>Provence</i> —————	277	or 1662
<i>La Massane</i> in <i>Roussillon</i> —————	397	— 2382
The same according to another Observation ———	408	— 2448
<i>Bugarach</i> a Mountain in <i>Languedoc</i> —————	648	— 3888

Mountains in *Auvergne*.

<i>Le Puy de Domme</i> , near <i>Clermont</i> ———	810	— 4860
<i>La Courlande</i> —————	838	— 5028
<i>La Coste</i> —————	851	— 5106
<i>Le Puy de Violent</i> ———	853	— 5118
<i>Le Cantal</i> ———	984	— 5904
<i>Le Mont d'or</i> ———	1030	— 6180

In the County of *Avignon*.

<i>Le Mont Ventoux</i> —————	1036	— 6216
------------------------------	------	--------

Pyrenean Mountains.

<i>S. Barthelemy dans le paix de foix</i> ———	1185	— 7110
<i>La Montagne du Mouffet</i> ———	1258	— 7548
<i>Le Canigou</i> ———	1440	— 8640

Before I proceed farther, I must beg Leave to observe, that the Heights of these Mountains, in the main, seem rather too great. This indeed is easily accounted for, as they were measured by Trigonometrical Observations, which will, as I have taken Notice above, because



## Remarks on the Height of Mountains, &c.

because of the Refraction of the Air, give the Heights greater than they actually are. But what confirms it still more, is, that according to the Tables above, the Numbers which answer to the Heights of the Mercury, as they were observed at the Top of some of those Mountains, are considerably less, and that even *Monf. Cassini's* own Numbers, which yet we have by some undoubted Experiments shewn to be too great, fall often short. It will be enough to mention two or three Instances At the Tower of *Massane* in *Rouffillon*, the Mercury stood at  $25'' 5'''$ , and the Height of that Place was determined Trigonometrically, of \_\_\_\_\_ 397 Toises.

Now  $25'' 5'''$  answer according *Mariotte*, to \_\_\_\_\_ 342 0

According to *Cassini*, \_\_\_\_\_ 392 4

According to *Dr Scheuchzer* \_\_\_\_\_ 350 0

At the Top of the Mountain called *la Coste* in *Auvergne*, the Mercury stood, *Oct.* 9, 1700, at  $23'' 4'''$ , and the Height of this Mountain was determined Trigonometrically of \_\_\_\_\_  $-851^{\circ}$  Toises.

Now $23'' 4'''$ answer according to					
<i>Mariotte</i> , to _____	}	$644^{\circ} 1'$	}	diff.	{ $206^{\circ} 5'$
<i>Cassini</i> _____	}	$826 1$	}		{ $24 5$
<i>Dr Scheuchzer</i> _____	}	$661 5$	}		{ $189 1$

The Difference is still more considerable with Regard to the high Mountain *Mont d'Or* in *Auvergne*, the Height whereof was determined Trigonometrically to \_\_\_\_\_ } \_\_\_\_\_ 1040 Toises.

At the Top of this Mountain the Mercury fell, according to an Observation made by *F. Sebastien Truchet*, June 8, 1705, to  $22'' 11'''$ , which answer according to

<i>Mariotte</i> , to _____ $707^{\circ} 5'$ <i>Cassini</i> to _____ $925 1$ <i>Dr Scheuchzer</i> _____ $727 3$					
	}		}	diff.	{ $332^{\circ} 1'$
	}		}		{ $114 5$
	}		}		{ $312 3$

I come now to the Mountains of *Switzerland*. The Barometrical Observations made by my Father upon several of the highest will convince us, that they rise aloft, above all the neighbouring ones in *France*, *Spain*, *Italy*, and *Germany*. And that it must be so appears farther, because from their elevated Tops, they dispense their Waters to all the *European* Kingdoms and Provinces around them. Nay, I doubt not, but that they may vie in Height with the most considerable Mountains in any other Part of the known Globe. *Switzerland* it self, I mean it's Valleys and lower Parts, as they are considerably remote from the Sea, rise also in Proportion above the Level of it. 'Tis true, the Ascent thither is but gradual, in Proportion to the Remoteness.



ness. At *Zurich*, for Instance, which lies towards the Northern Borders of *Switzerland*, the mean Height of the Barometer hath been observed of  $26^{\circ} 5'$ , which give the Elevation of that Town, above the Level of the Sea, according to *Mariotte*, 205 Toises, 4 Foot, or  $1234'$ , according to *Dr Scheuchzer*,  $210^{\circ} 4'$ , or  $1264'$ , and according to *Cassini*,  $221^{\circ} 4'$ , or  $1330'$ . This Town is distant from the Mouth of the *Rhine*, which is the nearest Part of the Ocean, at least 375 *English* Miles, or an hundred marine *French* Leagues, and from *Genoa* which is nearest upon the Mediterranean, 225 *English* Miles, or 62 *French* marine Leagues. So that going down from *Zurich* Northwards towards the Sea, the Descent, or Fall, is but something more than 12 Foot, for a marine League of *France*, if we suppose a straight Line to be drawn from *Zurich* to the Sea-shore in *Holland*; but it is much greater going Southward towards the Mediterranean, where it comes at least to 20 Foot for one League. Nay, if we consider that the highest Mountains of *Switzerland* lie almost directly between *Zurich* and the Mediterranean Shores, we must allow so much more in Proportion, as those Mountains are elevated above the Horizon of *Zurich*, and how great and sudden this Elevation be, will appear by the following Observations.

At *Ennen Sewen gen Aweren* in the Ascent of the high Mountain *Freyberg*, in the Canton of *Glarus*, which lies South East of *Zurich*, the Mercury was observed Sept. 11, 1710, at  $23^{\circ} 10'$ , which gives the Height of that Place above the Level of the Sea, according to

<i>Mariotte</i>	—	—	—	—	—	$569^{\circ} 2'$	or	$3416'$
<i>Dr Scheuchzer</i>	—	—	—	—	—	$584$	4	— $3508$
<i>Cassini</i>	—	—	—	—	—	$712$	3	— $4275$

Upon *Scherf*, one of the Branches of the *Freyberg*, the Mercury fell Sept. 12, 1710, to  $21^{\circ} 8'$ , which gives the Height of that Part of the Mountain according to

<i>Mariotte</i>	—	—	—	—	—	$906^{\circ} 1'$	or	$5437'$
<i>Dr Scheuchzer</i>	—	—	—	—	—	$931$	2	or $5588$
<i>Cassini</i>	—	—	—	—	—	$1247$	4	or $7486$

Still higher upon *Blattenstock*, another Part of the same Mountain, the Mercury fell on the same Day to  $21^{\circ} 6'$ , which answer according to

<i>Mariotte</i> , to	—	—	—	—	—	$933^{\circ} 2'$	or	$5600'$
<i>Dr Scheuchzer</i>	—	—	—	—	—	$959$	2	or $5756$
<i>Cassini</i>	—	—	—	—	—	$1293$	3	or $7761$

Hence from *Zurich* to the *Blattenstock* near the Top of the *Freyberg*, there is, in less than three Days Journey, a Rise of 4366 Feet, according to *Mariotte*, and 4492, according to *Dr Scheuchzer*, that is,  
more



more than three times the Elevation of *Zurich* above the Level of the Sea.

At *Guppen ob Schwanden*, in the same Canton of *Glarus*, the Mercury was observed, *August* 5, 1705, at  $23^{\circ} 4'$ , which give, according to

<i>Mariotte</i>	—	—	—	—	—	—	$644^{\circ} 1'$	or	$3865'$
<i>Dr Scheuchzer</i>	—	—	—	—	—	—	$661^{\circ} 5'$	or	$3971'$

(I omit giving the Numbers according to the Tables of Mr *Cassini*, having already shewn, that they are too great) The Height of this Mountain is nearly the same with the celebrated *Puy de Domme*, where *Monf. Perier* observed the Mercury, *Sept.* 19, 1648, at  $23^{\circ} 2'$ .

Upon *Joch*, a high Mountain in the Territory of *Engelberg*, where it confines upon the Canton of *Bern*, full South of *Zurich*, the Mercury stood, *June* 23, 1706, at  $21^{\circ} 4'$ , which gives the Height of that Mountain according to

<i>Mariotte</i>	—	—	—	—	—	—	$961^{\circ} 0'$	or	$5766'$
<i>Dr Scheuchzer</i> ,	—	—	—	—	—	—	$987^{\circ} 4'$	or	$5926'$

This Mountain, though very high, is far from being the highest in that Neighbourhood, for next to it there rises another called the *Titlisberg*, covered with everlasting Snow, which we may, upon a moderate Computation, pronounce at least 1000 Foot higher than the Top of the *Joch*, and consequently one of the highest in the Country.

Upon the *Avicula*, by the *Italians* called *Monte del' Uccello*, and by some *S. Bernhard's Mountain*, from a Chapel built in Honour of that Saint, a high Mountain in *Rhætia*, towards *Italy*, the Mercury was observed, *July* 30, 1707, at  $22^{\circ} 11'$ , which give according to

<i>Mariotte</i>	—	—	—	—	—	—	$707^{\circ} 5'$	or	$4247'$
<i>Dr Scheuchzer</i>	—	—	—	—	—	—	$727^{\circ} 3'$		$4365'$

This Height must be understood only of that Part of the Mountain which is passed over by Travellers, the Mountain itself rising considerably above it, and the *Adula*, or  $\Delta\iota\alpha\delta\epsilon\lambda\lambda\alpha\varsigma$  of *Strabo*, *Geog.* Lib. III. of which the *Avicula* is only a Part, being still higher. The *Rhenus posterior*, or *Hinter Rhein*, and the *Moÿss*, which at last loses itself in the *Tessin*, near *Bellenzone*, not much above the Entry of the *Tessin* into the Lake of *Locarno*, arise upon this Mountain.

At *Santa Maria*, upon the *Luckmannier Berg*, by some *S. Barnaby's Mountain*, which is likewise a Branch of the *Adula*, the Mercury stood, *Aug.* 9, 1725, as upon the *Avicula*, at  $22^{\circ} 11'$ , which shews the Height of these two Places to be equal.

In the Alp *San Porta*, near the Source of the *Hinter Rhein*, *Rhenus posterior*, five Hours and a half from *Speluga*, *Splügen* in *Rhætia*, the Mercury was observed, *July* 29, 1707, at  $21^{\circ} 4'$ , where it stood likewise



likewise upon the above-mentioned Mountain *Joch*, whither the Reader is referred for the Height of this Alp. At *Splügen* itself, the Mercury stood the same Morning early, at  $23^{\circ} 4'$ , which give the Elevation of *Splügen* according to *Mariotte*  $644^{\circ} 1'$  or 3865, and according to Dr *Scheuchzer*,  $661^{\circ} 5'$  or 3971'. So that the Fall of the *Rhine* from the Alp aforesaid to *Splügen*, in five Hours and a half, comes, according to *Mariotte*, to 1901, and according to Dr *Scheuchzer*, to 1955 *Paris Feet* perpendicular.

At the *Capuchins*, upon the high Mountain *S. Gothard*, a celebrated Passage out of *Switzerland* into *Italy*, the Mercury stood, *June* 30, 1705, at  $22^{\circ} 0'$ , which gives the Height of that Passage, which with Regard to the highest Tops of *S. Gothard*, lies but as it were at the Foot of a high Mountain, according to *Mariotte*  $852^{\circ}$ , or 5112', and according to Dr *Scheuchzer*,  $875^{\circ} 5'$ , or 5255', above the Level of the Sea.

Upon the *Furca*, a high Mountain between the *Urseren Thal*, *Ursaria Vallis*, and the upper *Vallesia*, and one of the Branches of the *S. Gothard*, the Height of the Mercury in the Barometer was observed, *July*, 31, 1707, at  $21^{\circ} 5'$ , which give the Height of this Mountain above the Level of the Sea, according to *Mariotte*,  $947^{\circ} 1'$  or 5683', and according to Dr *Scheuchzer*,  $973^{\circ} 3'$  or 5841. Near this Mountain there are others, which cannot be less than 800 or 900 Foot higher.

These Mountains, I mean the *Avicula*, the *Luckmannier Berg*, the *S. Gothard*, and the *Furca*, together with the *Grimfula*, the *Crispalt*, the *Sempronier*, or *Sempronius Mons*, the *Adula*, and a Chain of others, are the *Lepontiæ Alpes* of *Pliny* \* and the *Summæ Alpes* of *Cæsar* †. They begin in the upper *Vallesia*, traverse the Canton of *Uri*, and so run on Eastwards, across the Country of the *Grisons*, towards *Tirol*. Their greatest Height above the Level of the Sea, may be fixed in round Numbers to 7500, or 8000 *Paris Feet*.

*Gemmius Mons*, the *Gemmi*, is a very high and steep Mountain in *Vallesia*, over which there is a Passage, but only in Summer-time, from the *Fruttinger Valley*, in the Canton of *Bern*, to the Mineral Waters at *Leük* in *Vallesia*. The Descent, on the South-side of this Mountain, is steep and frightful, even to the Aspect, beyond what can be imagined, being a narrow Path, cut on the Side of almost perpendicular Precipices, sometimes with trembling wooden Bridges, or Planks over the Clefts in the Mountain, and here and there supported with low Walls. Having been geometrically measured, it was found of 10110 Feet in Length, or rather Height, it's many Windings and Turnings included. At a small Cottage, called *Zur Dauben*, a poor resting Place for weary Travellers, being the highest

\* Lib. iii. cap. xx.

† De Bello Gallico, lib. iii.



*Remarks on the Height of Mountains, &c.*

Part of the Mountain which is passable, the Mercury subsided *July 1*, 1709, to 21'' 3''' which gives the Height of that Place, according to

<i>Mariotte</i>	_____	_____	_____	_____	974° 5' or 5849'
And Dr <i>Scheuchzer</i>	_____	_____	_____	_____	1002 0 or 6012

Not far from this Cottage, is a small mountainous Lake, called the *Dauben Sea*, or the *Pidgeons Lake*, encompassed on all Sides with high Mountains, the Tops whereof, for their Steepness, it would be impossible to reach. At *Kandelstag*, the first Village in the *Fruttinger Valley*, in the Territory of *Bern*, going up to the *Gemmi*, the Mercury rose on the same Day to 24'' 2''' which give according to

<i>Mariotte</i>	_____	_____	_____	_____	520° 1' or 3121'
Dr <i>Scheuchzer</i>	_____	_____	_____	_____	534 1 or 3205

And at *Müllenen*, at the Foot of the *Gemmi*, it stood at 25' 7''' which answer according to

<i>Mariotte</i>	_____	_____	_____	_____	318° 5' or 1913'
Dr <i>Scheuchzer</i>	_____	_____	_____	_____	327 0 or 1962

On the other Side of the *Gemmi*, at *Leück*, a celebrated Place for it's Mineral Waters, the Mercury was observed *July 2*, and *July 5*, 1709, at 23'' 9''' which answers according to *Mariotte*, to 581° 4', or 3490', and according to Dr *Scheuchzer*, to 597° 3', or 3585'. So that the Cottage *Zur Dauben*, rises above *Leück*, according to

<i>Mariotte</i> ,	_____	_____	_____	_____	2359'
Dr <i>Scheuchzer</i>	_____	_____	_____	_____	2427

Above *Müllenen*, in the *Frutinger Valley*, according to

<i>Mariotte</i>	_____	_____	_____	_____	3936'
Dr <i>Scheuchzer</i>	_____	_____	_____	_____	4050

And the perpendicular Height of the *Gemmi*, above the Level of the Sea, considerably exceeds 6000 *Paris Feet*.

But high above all the Mountains of *Swisserland* rises the *Stella*, *Piz Stail*, a steep Mountain in the *Schamser Valley*, in *Rhætia*, or the *Grisons*, the Height whereof was by my Uncle Dr *John Scheuchzer*, by some Observations made in the Year 1709, determined to 9585 *Paris Feet*, above the Level of the Sea, according to his own Calculation, or 9441 according to *Mariotte*, and 12196 according to *Cassini*: A Height, which the *Rupicapra*, or *Shamoys* themselves scarce venture to ascend. And 'tis to these only, and the like Heights the following Verses of *Silius Italicus* ought to be applied:

*Cuncta*



*Cuncta gelu, canâque æternum grandine tecta,  
Atque ævi glaciem cobibent: riget ardua montis  
Ætherei facies, surgentique obvia Phæbo  
Duratas nescit flammis mollire Pruinas.  
Nullum ver usquam, nullique æstatis honores,  
Sola jugis habitat diris, sedesque tuetur  
Perpetuas deformis hyems—*

The Mountains are much more abrupt, and steep, and the Precipices greater to the South, than to the North, and Westwards than Eastwards. Many Instances of this might be given in particular Mountains in *Switzerland*, as the *Gemmi*, the *Mons fractus*, and so forth; but it is also evidently true with Regard to the whole. Those are the highest Mountains, which separate *Vallesia*, the Canton of *Uri*, and the several Leagues of the *Grisons*, from *Savoy*, *Piemont*, and the *Tirol*, which lie to the South, or South-East. Those very Countries are, as it were, one continued Set of high Mountains, quite to the *Mediterranean Sea*, and the like Structure seems to be continued farther on into that Sea itself. The *Pyrenean* Mountains also are but a Continuation of that vast Chain, which begins in the *Leponticæ Alpes*, or the Mountains in the upper *Vallesia*, the Canton of *Uri* and *Rhætia*, and from thence spreads itself chiefly West and South. On the contrary to the East and North they break off by Degrees into gentle Plains, which appears evidently by the vast Tracts of Ground, which the *Rhine* for Instance, and the *Danube* compass, before they lose themselves, the one into the *German Ocean*, the other into the black Sea, whereas the *Rhofne*, on the other Side, quickly, and with proportionable Velocity, reaches the *Mediterranean*. The same Observation, with Regard to the abrupt Steepness of Mountains to the South and West, holds true in other Parts of *Europe*, remarkably in *England* and *Norway*, more or less in other Countries. And so far as our Maps, and the Accounts of Travellers go, the same Thing is observable in other Parts of the World, but most evidently in the high Mountains of *Peru* and *Chili* in *South America*, which terminate very abruptly Westwards into the *Pacifick Sea*, but gradually decline to the East into immense Plains, watered by some of the most considerable Rivers in the known World, particularly the *River of Amazons*, and the *Rio della Plata*, which arise in the said Mountains.

To conclude, from what hath been hitherto said, it appears evidently, that the Mountains of *Switzerland* are the highest of *Europe*, they are also the great Store-house, whence all the Countries around them are supplied with Water; conformable to what the learned *Loritus Glareanus* hath long since elegantly expressed in the following Verses.

*Præterea caput Europæ hanc esse probabunt:  
Æternis Alpes nivibus, juga Olympica, quorum*



*Porgitur in cælum caput, & sub Tartara venter :  
 Et quod ad Auroram, Boream, Solemque cadentem  
 Flumina perpetuo non deficientia cursu  
 Parturit, illa volant & in omnia membra redundant,  
 Ad Zephyrum & Libyen Rhodanus, Rhenana furentem  
 Unda citat Boream, gelidus rotat Ister ad Eurum  
 Dirus aquas, Getico novus Hospes & advena Ponto.  
 Astalios fileo quos Italia accipit amneis  
 Alpibus à nostris, quæque alto à vertice montes  
 Agmina disparibus fundunt latissima Sultis.*

*Observations  
 concerning the  
 Height of the  
 Barometer, at  
 different Ele-  
 vations above  
 the Surface of  
 the Earth, by  
 Dr Nettleton,  
 No. 388. p.  
 308.*

IX. Being curious to learn by Observations, how far the Mercury will descend in the Tube at any given Elevation, for which there is sufficient Opportunity hereabouts, I proposed to take the Altitude of some of our highest Hills; but, when we attempted it, we found our Observations so disturbed by Refractions, that we cou'd come to no Certainty. Having measur'd one Hill of a considerable Height, in a clear Day, and observed the Mercury at the Bottom and at the Top, we found, according to that Estimation, that about 90 Feet, or upwards, were required to make the Mercury fall one Tenth of an Inch; but coming afterwards to repeat the Experiment on a cloudy Day, when the Air was somewhat gross and hazy, we found the small Angles so much augmented by Refraction, as to make the Hill much higher than before, tho' they were taken carefully with very good Instruments, both at that Time and before. I afterwards frequently observed at home, by pointing the Quadrant to the Tops of some of our neighbouring Mountains, that they would appear higher in the Morning before Sun-rise, and also late in the Evening, than at Noon, in a clear Day, by several Minutes: Particularly, one Morning in *December* last, when the Vapours lay condens'd in the Vallies, and the Air above was very pure, the Top of a Mountain, at some Distance from hence, appear'd more elevated, by above 30 Minutes, than it had done in the Beginning of *September* about Noon, on a very clear Day. From whence it appears, that the Refraction is at some times greater than at others; but probably 'tis always very considerable, and, as there is no certain Rule to make Allowance for it, it seems likely, that all Observations made on very high Hills, especially when view'd at a Distance, and under small Angles, as they commonly are, are uncertain, and scarce to be depended on, generally erring in making the Heights greater than they really are.

I then proceeded to observe, as near as I was able, the Alteration of the Mercury in some smaller perpendicular Elevations, which we could measure with a Line, and also on the Tops of some Hills of a moderate Height, whose Altitude we could observe most commodiously, and, by taking the Angles large, avoid the Danger of any considerable Refraction,



At the Bottom of the Tower of *Halifax* Church, the Mercury stood at 29. 78. At the Top it subsided to 29. 66. The Height of the Place, where the Observation was made, was found to be 102 Feet.

At the Bottom of a Coal-Mine, near this Place, the Mercury stood at 29. 48. At the Top, it fell to 29. 32. The Depth of the Mine, being measured, was found to be 140 Feet.

At the Bottom of another Mine, the Mercury was observed to stand at 29. 50. At the Top, it fell to 29. 23. The Depth of this Mine was 236 Feet.

At the Foot of a small Hill, whose Height we cou'd measure very exactly, the Mercury stood at 29. 81. At the Top it fell to 29. 45. The Height of the Hill was 312 Feet.

At the Bottom of *Halifax* Hill, commonly called the Bank, the Mercury was observed to stand at 30. 00. At the Top, it fell to 29. 41. The Height of this Hill was found to be 507 Feet.

Our Mathematicians demonstrate, that the Density of the Air decreases in a Geometrical Progression, as the Elevation encreases in an Arithmetical one, and consequently, that the Logarithms of the Densities are as the Elevations reciprocally. But the Weight of the Air being as its Density, and the Height of the Mercury in the Barometer being always proportional to the Air's Weight, it follows, that the Logarithms of the Heights of the Mercury are, reciprocally, as the Elevations: Whence having found by Observation, what Elevation is requir'd to make the Mercury stand at any given Height, it will be easy to determine, how much is requisite to reduce it to any other Height propos'd. If we make 30 Inches the Standard Height of the Mercury, equal to Unity, and suppose an Elevation of 85 Feet be requir'd to make it fall one Tenth of an Inch from that Height, as by these Observations it is very nearly; then as the Logarithm of  $\frac{30,0}{29,9}$  is to 85, so is the Log.

$\frac{30,0}{29,5}$  to the Number of Feet requir'd to make it fall Half an Inch, and so of the rest. When the Mercury stands above 30 Inches, the Numbers will be negative, and shew the Spaces descending; by which Method I computed the following Tables.

The latter, which contains the Differences of the Numbers in the former, was of very great Use to me, when, in these Experiments, the Mercury stood at any other Height in the Tube, besides 30 Inches, and fell any Number of Tenths, or Parts of a Tenth, by adding the Numbers answering thereto, or proportionable Parts of them, to find the Elevation requir'd in the Table, to make the Mercury fall so much, and thereby readily to compare the Heights found by Observation therewith. And though some small Errors,



*Observations concerning the Height of the Barometer, &c.*

in the Observations, do make them vary a little from each other, yet in the main they agree as near as possible with the Numbers of the Table ; as did also several other Experiments too long to mention, which makes me believe those Numbers are not far from the Truth ; but of that you will be best able to judge, by comparing these Experiments with others of the same Kind.

That the Air is colder, as well as more light and rare, in Places that are situated high, than it is in the Vallies and low Grounds, is generally known ; and in order to learn, how much it might be so, I got a Friend of mine, who lives higher than we do here, to observe the Portable Barometer and Thermometer, at his House, for some Days, being plac'd as near as possible in the same Circumstances with mine ; and we found his Barometer stood at a Medium for 20 Days, 3 Tenths lower than mine, and the Thermometer 3. *deg.* 2. lower ; allowing for the Difference of the Instruments, which had been observed before.

At another Place the Barometer, at a Medium for 14 Days, stood lower by 4. 46. and the Thermometer was lower by 4 *deg.* 4. At another Place, which was very high upon the Moors, the Barometer, at a Medium for ten Days, stood lower by 0. 65. and the Thermometer fell 7°.

A TABLE



A TABLE shewing the Number of Feet ascending, required to make the Mercury fall to any given Height in the Tube, from 30 to 26 Inches. As also the Number of Feet descending, requir'd to make the Mercury rise, from 30 to 31 Inches.

A TABLE shewing the Number of Feet requir'd to make the Mercury fall one Tenth of an Inch from any given Height in the Tube, from 31 to 26 Inches.

In. Dec.	Feet Dec.	In. Dec.	Feet Dec.
31 0	834	27 9	1847 55
30 9	752	27 8	1938 97
30 8	670	27 7	2030 72
30 7	587	27 6	2122 80
30 6	504	27 5	2215 21
30 5	420	27 4	2307 95
30 4	337	27 3	2401 02
30 3	253	27 2	2494 44
30 2	169	27 1	2588 20
30 1	84	27 0	2682 33
30 0	00	26 9	2776 80
29 9	85	26 8	2871 62
29 8	170	26 7	2966 79
29 7	255	26 6	3062 32
29 6	341	26 5	3158 21
29 5	427	26 4	3254 46
29 4	514	26 3	3351 07
29 3	601	26 2	3448 05
29 2	688	26 1	3545 41
29 1	775	26 0	3643 14
29 0	863		
28 9	951		
28 8	1039		
28 7	1127		
28 6	1216		
28 5	1305		
28 4	1395		
28 3	1485		
28 2	1575		
28 1	1665		
28 0	1756		

In. Dec.	Feet Dec.	In. Dec.	Feet Dec.
31 0	82 26	27 9	91 42
30 9	82 53	27 8	91 75
30 8	82 79	27 7	92 08
30 7	83 06	27 6	92 41
30 6	83 33	27 5	92 74
30 5	83 61	27 4	93 07
30 4	83 89	27 3	93 41
30 3	84 16	27 2	93 76
30 2	84 44	27 1	94 12
30 1	84 72	27 0	94 47
30 0	85 00	26 9	94 82
29 9	85 29	26 8	95 17
29 8	85 58	26 7	95 53
29 7	85 86	26 6	95 89
29 6	86 16	26 5	96 25
29 5	86 45	26 4	96 61
29 4	86 74	26 3	96 98
29 3	87 03	26 2	97 36
29 2	87 33	26 1	97 73
29 1	87 63	26 0	98 10
29 0	87 93		
28 9	88 24		
28 8	88 55		
28 7	88 86		
28 6	89 17		
28 5	89 49		
28 4	89 81		
28 3	90 13		
28 2	90 45		
28 1	90 76		
28 0	91 09		



*A Barometrical Experiment by And. Celsius, from the Act. Lit. Sueciæ Ann. 1724. Trimestr. IV. No. 388. p. 313.*

X. Ad variationem columnæ mercurialis observandam, pro diversa altitudine regionum atmosphæræ, fodinæ nostræ profundiores in primis idoneæ censerî debent. Harum enim profunditatem non modo omni exactitudine metiri; sed & brevi temporis spatio observationem totam absolvere licet. Quo sane commodo haud raro destituuntur, quibus circa altiores montes hæc talia experiri animus est. Si itaque quamplurima in variis fodinis instituerentur experimenta; nulli dubitamus, quin vera progressio, quâ densitates aëris decrescant, tandem sua sponte se proderet.

In magna fodina Cuprimontana argenti vivi ascensum a viro amplissimo *Georgio Vallerio* dudum observatum esse, ex litteris ipsius ad Cl. *De La Hire* d. 15 Julii, A. 1711. Fahlunæ datis, certiores redimur. \*

In argenti vero fodina Salana, septem fere milliaribus ab Upsalia versus occidentem distita, hujus rei periculum a me factum est die 28 Aug. currentis anni. Scilicet juxta limen putei *Reginæ Christinæ*, (*Drottning Christinæ Schatcht*,) hydrargyri altitudinem 30 digit. & 38 centes. seu  $\frac{3038}{1200}$  pedis Suecani observavi. Cum Barometro deinde in tonna, quæ funi adpensa machina hydraulica trahitur, ad profunditatem 636 pedum me demisi; ubi mercurius ad 30 dig. 98 centes. ascendisse deprehensus est. Inde iterum evectus ad orificium putei, in eadem ac antea altitudine, nempe 30 dig. 38. cent. columnam mercurialem notavi. Adeo ut hydrargyrum 636 ped. in aëre elatum 6 lineas seu  $\frac{6}{120}$  ped. descenderit; & sic consequenter, si aër æque densus ubique supponeretur, unius lineæ in cylindro mercuriali variatio, 106 ped. altitudini perpendiculari corresponderet. Horæ illius intervallo, quo integra perficiebatur observatio, cœlum erat pluvium nonnihil & ventosum; nulla tamen sensibilis mutatio, columnæ mercurialis in alio Barometro supra fodinam parieti affixo, isto tempore videri potuit.

Postero die, aëre sereno & tranquillo, ad basin templi urbis *Salæ*, haud procul a fodina distantis, argentum vivum 30 dig. 36 cent. altum hæsit, altitudinem vero 145 ped. in turri ejusdem templi scandens, mercurium ad 30 dig. 23 cent. substituisse deprehendi, ut unius lineæ in Barometro descensui, altitudo  $111\frac{7}{13}$  ped. respondeat. Basis templi 60 fere pedes infra superficiem fodinæ deprimitur. Ipsius autem fodinæ elevationem supra mare Balticum explorare nondum licuit.

Ut hæc nostra observatio cum exterorum hujus generis experimentis rite conferri queat, notandum est inter pedem Suecanum & Parisinum Regium eam rationem intercedere, quæ est inter 1000 & 1096, seu 125 & 137 proxime; quam ex pede Gallico orichalceo, insignis artificis *Chapotot* manu insculpto, cum pede *Stiernhielmiano*, qui in Bibliotheca publica Upsal. servatur, collato, exactissime observavi.

\* *Vid. Memoires de l'Acad. R. des Sc. l'ann. 1712. p. 108.*



XI. It has, I believe, been generally supposed, tho' not proved, that the Expansion of the Liquor in the Thermometer, is proportional to the Increase of Heat. To determine this Matter with Certainty, I made the following Experiment.

I provided a good Linseed Oil Thermometer, which I marked with small Divisions, not equal in Length, but equal according to the Capacity of the Tube in the several Parts of it, as all Thermometers ought to be graduated. I likewise provided two Vessels of thin Tin, of the same Shape, and equal in Capacity, containing each about a Gallon. Then (observing in every Trial, that the Vessels were cold, before the Water was put in them, as also that the Vessel I measured the hot Water with, was well heated with it) I successively filled the Vessels with one, two, three, &c. Parts of hot boiling Water, and the rest cold; and at last with all the Water boiling hot; and in every Case I immersed the Thermometer into the Water, and observed to what Mark it rose, making each Trial in both Vessels for the greater Accuracy. And having first observed where the Thermometer stood in cold Water, I found that its rising from that Mark, or the Expansion of the Oil, was accurately proportional to the Quantity of hot Water in the Mixture, that is, to the Degree of Heat.

*An Experiment, made to ascertain the Proportion of the Expansion of the Liquor in the Thermometer, with Regard to the Degrees of Heat. By Brook Taylor, LL.D. F.R.S. No. 376. pag. 291.*

XII. Cum elapsis abhinc circitur decem annis in Historiâ Scientiarum Societatis Regiæ Parisiensis legissem quod celeberrimus *Amontoni*, ope alicujus thermometri ab eo inventi, detexisset, aquam fixo caloris gradu ebullire; statim magno accendebam desiderio, thermometrum ejusmodi mihi met ipsi præparare, ut pulchrum hocce naturæ phænomenon mihi oculis perlustrare liceret, & de veritate experimenti convictus essem.

*Experiments concerning the Heat of boiling Liquors, by D. G. Fahrenheit F.R.S. No. 381. pag. 1.*

Qua propter Thermometri structuram quidem tentabam, sed ob habitudinis sufficientis in elaboratione illius defectum, vana erant conamina, licet sæpius iterata; & quoniam etiam alia negotia prohibebant thermometri elaborationi magis insistere, opportunitate repetitionem illius dedicabam tempori. Cum defectu virium atque temporis ardor non languescebat, æque avidus enim experimenti exitum videndi manebam. In mentem autem mihi veniebant ea, quæ solertissimus ille rerum naturalium scrutator de rectificatione barometrorum scripserat; observaverat enim altitudinem columnæ mercurialis in barometro a vario temperamento mercurii aliquantulum (satis sensibilibiter tamen) turbari. Ex his rebar, quod thermometron fortasse e mercurio construi posset, cujus structura non adeo difficilis foret, & cujus tamen ope experimentum maxime a me desideratum explorare liceret.

Præparato ejusmodi thermometro (licet in multis adhuc imperfecto) voto tamen meo eventus respondebat magnâ enim animi voluptate rei veritatem contemplabar.



*Experiments concerning the Heat of boiling Liquors.*

Exitus experimentorum sequenti continetur tabula, cujus prima columna exhibet liquores adhibitos; secunda illorum gravitatem specificam; tertia gradum caloris, ad quem unusquisque liquor ebulliendo pertigit.

Liquores.	Gravitas specifica Liquorum ad 48 Gr. calidorum.	Gravitas specifica Liquorum ad 48 Gr. calidorum.	Gravitas specifica Liquorum ad 48 Gr. calidorum.
<i>Spiritus vel Alcohol vini.</i>	8260	176	
<i>Aqua Pluvia.</i>	10000	212	
<i>Spiritus Nitri.</i>	12935	242	
<i>Lixivium cineris clavellati.</i>	15634	240	
<i>Ol. Vitrioli.</i>	18775	546	

Gravitatem specificam cujusunque liquoris addendam necesse judicavi, ut si aliorum experimenta jam instituta, vel adhuc institutenda, a memoratis differrent, colligi possit, an e variatione gravitatis specificæ, vel ex aliis differentia petenda sit causis. Experimenta præterea non eodem tempore sunt facta, & inde etiam liquores vario temperamenti vel caloris gradu erant affecti, sed quoniam illorum gravitas diversimode & inæqualiter turbatur, calculo illorum gravitatem ad 48 gradum (qui in thermometris meis medium tenet locum inter terminum intensissimi frigoris arte commixtione aquæ, glaciei, salisque Ammoniæ, vel etiam maritimi, confecti, & inter terminum caloris, qui in sanguine hominis sani reperitur) revocavi.

Olea Volatilia aliquo gradu quidem incipiunt ebullire, sed eorum calor ebulliendo semper augetur. Cujus rei causa fortasse erit, quod nempe volatiliores particulæ avolent, dum resinosa majori attractione præditæ restant.

Olea fixa autem tanto calore afficiuntur, ut Mercurius in thermometro simul cum illis ebullire incipiat, & inde eorum calor memorato modo vix certe explorari poterit. Sed alium excogitavi modum, cujus in alia scheda coram Illustri Societate Regia meminisse me honorem habiturum esse spero.

Excepto spiritu vini & aqua, fortasse etiam gradus cæterorum liquorum hic commemoratorum variabit, precipue si magna satis quantitate adhibeantur & longius ebulliant.



XIII. Inter plurima admiranda Naturæ Phænomena aquarum congelationem non minoris momenti esse semper judicavi; hinc sæpe experiundi cupidus fui, quinam effectus frigoris futuri essent, si aqua in spatio ab aëre vacuo clauderetur. Et quoniam dies secundus, tertius & quartus Martii, (Styli V.) Anni 1721. ejusmodi experimentis favebat, hinc sequentes observationes & experimenta a me sunt facta.

*Experiments and Observations concerning the freezing of Water in vacuo, by the same No. 382. pag. 78.*

Antequam autem experimentorum recensitionem aggrediar, necesse erit ut paucis quædam de thermometris, quæ a me construuntur, eorumque scalæ divisione, ut & de methodo evacuandi, qua usus sum, mentionem faciam. Duo potissimum genera thermometrorum a me conficiuntur, quorum unum spiritu vini & alterum argento vivo est repletum: Longitudo eorum varia est, pro usu, cui inservire debent: Omnia autem in eo conveniunt, quod in omnibus scalæ gradibus concordent, interque limites fixos variationes suas absolvant. Thermometrorum scala, quæ meteorologicis observationibus solummodo inserviunt, infra a Zero incipit & 96<sup>to</sup> gradu finitur. Hujus scalæ divisio tribus nititur terminis fixis, qui arte sequenti modo parari possunt; primus illorum in infima parte vel initio scalæ reperitur, & commixtione glaciei, aquæ, & salis Ammoniaci vel etiam maritimi acquiritur; huic mixturæ si thermometron imponitur, fluidum ejus usque ad gradum, qui zero notatur, descendit. Melius autem hyeme, quam æstate hoc experimentum succedit. Secundus terminus obtinetur, si aqua & glacies absque memoratis salibus commiscentur, imposito thermometro huic mixturæ, fluidum ejus tricesimum secundum occupat gradum, & terminus initii congelationis a me vocatur; aquæ enim stagnantes tenuissima jam glacie obducuntur, quando hyeme liquor thermometri huncce gradum attingit. Terminus tertius in nonagesimo sexto gradu reperitur; & spiritus usque ad hunc gradum dilatatur, dum thermometrum in ore vel sub axillis hominis in statu sano viventis tam diu tenetur donec perfectissime calorem corporis acquisivit. Si vero calor hominis feбри vel alio morbo fervente laborantis investigandus est, alio thermometro utendum, cujus scala usque ad 128 vel 132 gradum prolongata est. An autem hi gradus ferventissimo calori alicujus febris sufficiant nondum expertus sum, vix tamen credendum, quod cujusdam febris fervor gradus memoratos excedere debeat. Thermometrorum scala, quorum ope ebullientium liquorum gradus caloris investigatur, etiam a zero incipit & 600 continet gradus, hoc enim circiter gradu Mercurius ipse (quo thermometron repletum est) incipit ebullire.

Ut autem quoque thermometra ab omnibus mutationibus caloris celeriter afficiantur, loco globulorum cylindris vitreis sunt prædita, eo enim modo ob majoris superficiæ quantitatem citius a variatione caloris penetrantur.

Postquam breviter mentionem feci de constructione thermometrorum meorum, adhuc describendus erit modus evacuandi, quo in experimentis



## *Experiments concerning the Freezing of Water*

perimentis initio memoratis usus sum. Globulus vitreus A tubulo B C duorum vel trium pollicum longo in extremitate C attenuato præditus supra ignem calefit, quo facto tubuli extremitas aquæ immergitur, & tam diu in aqua relinquitur donec refrigeratione aëris in globulo contenti, guttulis aliquibus aquæ sit repletus, deinde iterum supra flammam latiore lampadis cujusdam, vel supra prunas ope forcipis parvæ tenetur, donec aqua in globo contenta incipit ebullire, & vapor aquæ impetu instar Æolipilæ erumpit: Hæc ebullitio aquæ aliquantulum continuatur, quo facto globulus ab igne removetur, & extremitati ejus flamma candelæ appropinquatur. Refrigerescente globulo vapor ab igne rarefactus etiam successive condensatur, vaporumque egressus paulatim diminuitur, qui postquam plene cessavit, in ipso etiam momento extremitas tubuli colliquescit, globulusque hermetice sigillatus & ab aëre evacuatus redditur. An vero hoc modo probe ab aëre evacuatus sit, experiri potest, si nempe extremitas tubuli sub Mercurio diffringitur, totus enim globulus Mercurio replebitur, si diffractione caute sine introitu aëris externi fuerit peracta. Diffractione extremitatis etiam sub aqua perfici potest, sed licet summâ curâ peragatur, globus tamen non tam perfecte aqua replebitur; dum enim aqua globum evacuatum intrat, aër, qui semper in aliqua quantitate aquæ commixtus est, ab illa in minutissimis bullulis separatur, quæ postquam coiverunt sub specie bullulæ majoris in globulo apparent. Eodem modo globus ab aëre evacuari potest, si tertia, dimidia vel major pars globi aqua repleta desideratur; desiderata enim quantitate aquæ prius impletur & deinde post ebullitionem aquæ hermetice clauditur. His explicatis ad recensitionem experimentorum pervenio.

Globulum vitreum, cujus diameter uni circiter pollici æquabat, memorato modo ab aëre evacuatum, & aqua pluviali fere ad dimidiam partem repletum, die secundo *Martii* Anni 1721, frigoris rigori exponebam. Aëris temperies in thermometro appposito quindecimo gradu notabatur. Elapso horæ spatio, aquam adhuc fluidam in globulo reperiēbam, cujus rei causam esse arbitrabar, quod nempe aqua nondum bene a frigore esset penetrata, ut autem dubii omnis tolleretur scrupulus, globum per totam noctem aëri expositum relinquebam. Sequenti die tertio *Martii* ad horam matutinam quintam aquam adhuc fluidam inveniebam & liquor thermometri eundem adhuc notabat gradum, cujus improvise phænomeni causam aëris absentiæ attribuebam. Ut autem hujus conjecturæ veritas mihi innotesceret, diffringebam tubuli extremitatem, ut spatium vacuum globuli iterum aëre repleretur, quo facto tota aquæ massa celerrime tenuissimis glaciei lamellis permiscebatur. Placebat mihi autem antequam experimenti repetitio fieret, alio experimento explorare, an hæc lamellæ glaciales aquæ innaturæ essent, quapropter globum diffringebam partemque aliquam glaciei aquæ vitreo poculo contentæ injiciebam, & illam aquæ innatare conspiciebam.



Dum autem forte oculos admodum brevi temporis intervallo in alium quendam direxeram locum, aspiciendo iterum poculum, totam aquam glacialibus lamellis permixtam cernebam, manente tamen adhuc in interstitiis lamellarum plurimâ aquæ parte fluidâ. Thermometron huic mixturæ impositum, trigessimum secundum notabat gradum. Attentiori autem animo & oculo hæc phænomena contemplari cupidus, experimentum duobus aliis globulis repetere resolvebam: postquam igitur priori modo præparati erant, illos per horæ spatium aëri externo exponebam, liquor autem thermometri interea jam vigesimum attigerat gradum. Elapfa hora aquam in ambobus globulis adhuc fluidam inveniebam, postquam autem spatium vacuum globuli aëre iterum repletum erat, citissime etiam aqua (ut in priori experimento) lamellis glacialibus permiscebatur, illarumque generatio tam subitanea erat ut vix oculis assequi poterat. Et quoniam lamellarum generatio, quæ in poculo vitreo erat facta, observationem meam effugerat, hinc adhuc maxime curiosus eram, illarum generationem paulo attentius contemplari. Priusquam autem globulorum alterum diffringebam, aquam memorato poculo contentam a lamellis glacialibus separabam quo facto globulum diffringebam, glaciem in globo generatam aquæ injiciebam. Glacies injecta quidem aquæ innatabat, sed lamellarum generatio in poculo frustra a me expectabatur. Ob negotiorum quorundam necessitatem, experimentorum continuationem advenienti dedicabam nocti. Quæ postquam advenerat, iterum hora undecima tres globulos sævienti gelu exponebam. Horum duo ad dimidiam circiter partem, iterum aqua erant repleti, manente residua parte globulorum vacua, in tertio vero solummodo quarta circiter pars globuli erat vacua. Aëris temperies in thermometro appposito vigesimo sexto notabatur gradu. Hora quarta matutina eundem statum temperiei aëri adesse thermometro deprehendebam, & aquam in duobus globulis, qui tantum pro dimidia parte aqua modo erant repleti, adhuc fluidam inveniebam: in tertio autem aqua congelata, atque globus diffractus erat. Glacies minutissimis sed admodum paucis permixta erat bullulis, pelluciditasque ejus maxime perturbata apparebat & confusæ crystallizationi alicujus salis simillima erat. Hujus experimenti contrarium successum invisibili cuidam fissuræ attribuebam, quâ aër externus introitum invenerat atque ita congelationem aquæ procreaverat.

Quoniam autem magno adhuc flagrabar desiderio, lamellarum generationem in poculo vitreo attente contemplari, idcirco vas vitreum e cubiculo in illam afferebam cameram ubi hæc experimenti fiebant, dum autem scalas paucas, quæ ad illam ducebant cameram, ascendere volebam, deficiebam scalam aliquam pede bene attingere, quo facto aqua vitro contenta ruditer commovebatur, atque eo ipso momento tota ejus massa plurimis permixta apparebat glacialibus lamellis. Hoc autem casu infortunio edocebar, glaciem in aqua satis frigida agitatione produci posse; curiosus inde eram experimento explorare:



plorare, an congelatio aquæ etiam in spatio vacuo agitatione futura esset. Postquam igitur globulum aliquantum agitaveram, magna animi voluptate eundem phœnomeni eventum cernebam, simulque iudicii errorem agnoscebam, quod nempe absentiæ aëris fluiditatem aquæ attribuissem. Interea e thermometro agnoscebam, gelu multum languescere, liquor enim jam ad vigesimum octavum ascenderat gradum, cito igitur manu dissolvebam glaciem, globulumque unum iterum aëri exponebam (erat autem alter casu infortuito diffractus). Relicto globo per dimidium circiter horæ spatium, gelu adhuc magis remittere observabam, thermometri enim liquor jam ad gradum trigessimum secundum pervenerat. Et quoniam verebar, ne remissione frigoris experimenti repetitio vana futura esset, si diutius globulus aëri relinqueretur expositus: hinc ipso tempore, agitatione globuli aquæ congelationem procreare tentabam; sed licet fortiter agigaretur, non minima tamen congelationis apparebant indicia. Cum vero hoc modo omnis congelationis spes evanuerat, adhuc experiri volebam, an congelatio successura esset, si spatium vacuum globuli iterum aëre repleretur. Diffracta igitur extremitate tubuli, minutissimæ glaciei spiculæ per totam aquæ massam diffusæ generabantur, quæ circumrotatione aquæ superficiem petebant, arænenissimumque spectaculum reflectione luminis ab earum politis superficiebus præbebant. Quoniam autem hujus hyemis gelu hoc die finiebatur & cum illo experimentorum continuationi finis imponebatur, quam vero tempori opportuniori aliis excogitatis experimentis instituere mihi proponebam. Hyems anni 1722. ita mitis in *Hollandia* erat, ut per totam hyemem vix aquæ stagnantes glacie aliqua obducebantur. Et licet hyems initio anni 1723. multo severior erat, attamen negotiorum copia, aliorumque experimentorum major necessitas continuationem eorum prohibebant.

*An extraordinary Instance of the almost instantaneous freezing of Water; by Mr Triewald F. R. S. No. 418. p. 79.*

XIV. The 15th of *December* last coming into the Hall, where my *Apparatus* is placed, in the Palace of the Nobility at *Stockholm*, the Weather being very cold, I feared that the Glafs for shewing the Experiment with the *Cartesian Devils* (or those glafs Figures in Water, which by the Pressure of the Air on the Surface of the Water, are made to change their Places, and sink to the Bottom of the Glafs) would be in Danger, if the Water should freeze in the same. I took it down from the Shelf, and was well pleased to see the Water in a fluid State; but before I would empty the Glafs, as some Friends that were present had not seen that Experiment, I placed my Hand on the Bladder tied on the Top of this Cylindrical Glafs, which was of a pretty large Size, sixteen Inches high, and three Inches and a half Diameter, containing three glafs Figures: In that very Instant, and in the Space of a Second of Time, I found all the Water changed into Ice; when in that Time two of the Figures had reached very near the Bottom, but the Third, as well as they, fixed in the Middle of the Glafs, surrounded with Ice as transparent as the Water itself before it congealed.



D. M.	Barom. Altitud.	Therm. Altitud.	Lat. North.	Long. West.	Variat. West.	Obs.	Wind.	Weather.
June 4	27	25	59° 12'	4° 44'	17° 00'	Obs.	SW.	Clofe.
5	22	25	59 38	5 11	16 00	Obs.	SW to NW.	Rain, and stormy Winds.
6	21	24	59 58	5 57	17 00		WSW.	Rain, and fresh Gales.
7	22	23	59 22	7 06	17 20		NW to SSW.	Rain and squally, with Fogs.
8	22	22	59 38	8 39	18 00	Obs.	SW to SE.	Much Rain all Night, fair at Noon.
9	23	22	59 54	8 47	18 00		NE.	Very cloudy.
10	20	22	59 14	10 14	18 00		North.	First Part squally, latter fair.
11	22	22	58 35	11 23	18 00		NW.	Squally with Rain.
12	22	25	57 21	12 20	18 00		NW.	Cloudy, with small Rain.
13	22	24	56 31	13 13	18 00		NW.	Squally.
14	25	25	56 00	14 22	18 00		NW to S.	First Part squally, latter hazy.
15	24	25	55 53	17 02	18 00	Obs.	E to N.	Squally, and fresh Gales.
16	20	23	55 42	18 16	18 00		NE to SW.	Cloudy.
17	19	23	56 21	18 47	18 00		SW to NW.	Rain and stormy.
18	18	22	55 22	19 34	18 30		NW.	Squally, with Rain.
19	20	23	55 42	21 14	19 00		NNE to WbS.	Cloudy with Rain, uncertain.
20	21	24	56 51	21 31	19 30		NW.	Fresh Gales, and foggy.
21	21	24	57 23	21 54	20 00		WNW to WbS.	An hard Rain, and stormy.
22	21	24	57 00	22 01	20 00		NE to W.	Hard Gales for the most Part.
23	21	24	57 56	23 52	21 00		WSW.	Fresh Gales, but cloudy.
24	23	24	58 16	24 09	22 00		W to WNW.	Hard Gales, cloudy.
25	24	23	57 40	24 38	22 00	Obs.	WNW to SW.	Cloudy, little Wind.
26	23	23	57 57	25 33	22 00		SW.	Little Wind, and foggy.
27	22	22	58 47	28 25	23 00		SW to W.	Foggy, and squally.
28	23	22	58 39	29 31	23 00		W to NNW.	Fresh Gales, Rain.
29	24	21	58 28	29 45	23 20		NW to W.	Moderate and calm.
30	25	22	58 00	30 38	24 00		W to SW.	Moderate, cloudy.
July 1	22	22	58 25	31 29	24 00	Obs.	WSW.	Moderate and clear.
2	20	22	59 13	32 54	25 00		SW to W.	Frequent Squalls, some Rain.
3	24	21	59 03	33 14	25 00	Obs.	WNW.	Moderate and cloudy.
4	25	22	58 54	33 30	25 00		WNW.	Fair, sometimes calm.
5	20	22	58 43	35 44	26 00	Obs.	SSE.	Sometimes calm. Fair.
6	20	22	58 26	37 25	26 30		SSE to W.	Stormy, and Rain.
7	21	20	58 06	39 30	27 30	Obs.	WNW to SE.	Moderate. Little Wind.
8	22	20	58 03	42 38	27 00		S to SW.	Foggy.
9	24	22	57 34	43 23	27 00		NNW.	Foggy. Little Wind.
10	24	24	57 43	45 25	27 00	Obs.	NNW.	Fresh Gales and clear.
11	28	28	58 11	46 47	27 00		WbS to NNW.	Cloudy, with small Rain.
12	29	26	57 34	48 17	28 00	Obs.	NNW to SSW.	Fair.
13	29	26	58 00	50 48	29 00		SW.	Hazy.
14	28	26	58 53	53 20	31 00		SW to WbS.	A thick Fog.
15	33	35	58 56	55 18	32 00		WNW to NW.	Small Rain, and squally.
16	38	37	59 06	55 33	34 00		NbW to NW.	Several Isles of Ice.
17	40	38	58 50	56 04	35 00		NNW.	Fair and clear. Very cold.
18	41	39	58 53	56 43	37 00	Obs.	NW to WSW.	Very cold. Much Ice.
19	40	38	59 45	58 03	36 00	Obs.	NW to WSW.	Fair and clear.
20	40	38	60 01	58 27	37 00		NNW.	Fair and moderate
21	42	38	59 51	59 59	37 00		NNW to SEbS.	Fair.
22	43	38	61 16	62 09	38 00		SSE.	Hazy.
23	43	39	61 50	63 34	40 00		SE.	In Hudson's Streights.
24	42	38	62 11	72 32	42 00	Obs.	SE.	Foggy.
25	40	35	63 11	76 22	40 00		SE.	Rainy and cold.

XV.  
*Observations  
on the Wea-  
ther, in a  
Voyage to  
Hudson's Bay  
in North-A-  
merica, in the  
Year 1730. By  
Capt. Christo-  
pher Middle-  
ton. No 418.  
page 76.*



## Observations on the Weather, &amp;c.

D. M.	Barom. Altitud.	Therm. Altitud.	Lat. North.	Long. West.	Variat. West.	Obs.	Wind.	Weather.
July 26	41	37	63° 12	78 04	40° 00	Obs.	S E.	Little Wind, and clear.
27	39	39	63 09	78 43	42 00		East.	Little Winds, sometimes calm.
28	37	38	62 10	81 12	40 00		SE to W b N.	Squally, with much Rain.
29	35	37	60 49	82 21	36 00		W b N to NE.	Gentle Rain. A fresh Gale.
30	38	36	58 24	84 09	33 00		N to NN W.	Much Ice all round.
31	40	38	56 51	84 27	28 00		N W.	Fair and clear. Ice still.
Aug. 1	43	39	56 15	83 46	24 00	Obs.	NW to W S W.	Fair. Ice as before.
2	42	38	56 20	84 16	24 00	Obs.	Sb W.	Mercy. inclosed in Ice. Fair.
3	40	38	56 27	83 44	24 00		South.	Still in Ice. Fresh Gales.
4	38	36	56 20	83 01	24 00		SW.	Foggy, and much Ice.
5	38	35	56 15	83 24	24 00		ESE.	Much Rain, and foggy.
6	40	37	56 00	82 46	24 00		WSW.	Fair and moderate.
7	40	39	55 08	82 43	24 00		ENE.	Lightning with some Rain.
8	38	36	55 11	82 43	24 00		N to NN W.	Fog. Fresh Gales. Jambed in Ice.
9	38	36	55 16	82 43	24 00		NN W.	Frost and calm.
10	34	31	55 22	82 40	24 00		South.	Fair and pleasant.
11	34	32	55 11	84 20	24 00		SW to NW.	Moderate.
12	31	30	55 06	84 36	24 00		NNW to Sb E.	Moderate and fair.
13	27	30	55 15	84 52	24 00		S to SSW.	A fresh Gale. Much Ice.
14	26	30	55 20	84 34	24 00		Sb W.	Hard Gale. Thunder and Rain.
15	26	27	54 44	84 34	24 00		WNW to NW.	Fresh Gales. In Ice.
16	29	27	54 28	84 34	24 00		NW to N.	Moderate and fair.
17	26	27	53 54	84 56	24 00		NE to Sb E.	Clear of Ice. Fair.
18	25	25	53 56	84 58	24 00		W b N to WSW.	A fresh Gale. Clear of Ice.
19	25	24	53 44	84 57	24 00		WSW to W b N.	Moderate and fair.
20	28	26	53 09	85 00	24 00		W b S to SE b S.	Moderate and fair.
21	28	25	52 31	85 30	23 00	Obs.	E to NE.	Moderate.

## In ALBANY Road

22	27	25	50° 29'	85° 20'	23° 00'	NW to SE.	Moderate and fair.
23	26	22				S. W.	Dry. Somewhat cloudy.
24	26	21				WNW.	Mercy. at a Stand.

The Time I was on Shore not observed. From ALBANY.

Sep. 2 | 25 | 20 | 53° 56' | 0° 30' | E 24° 00' | | S S W. | | Hazy, but small Gales.

## From the BEAR Islands.

Sept. 3	35	32	54° 22'	0° 7' W	24° 00'	SW to NE b N.	Mercy. suddenly falls to freezing.
4	40	37	55 45	0 49 W	25 00	NNE to WSW.	Hard Frost. Fair.
5	37	36	56 35	2 26 W	26 00	E b N to NE.	Cold Air. Squally, and foggy.
6	37	35	56 57	3 04 W	26 00	NE.	A wet Fog.
7	37	34	56 45	1 22 W	26 00	NE.	Moderate Gales.
8	38	36	57 06	3 26 W	26 00	NE b N.	Fresh Gales.
9	36	36	58 08	3 02 W	28 00	N b E to W.	Foggy.
10	36	38	60 25	2 02 W	33 00	WSW to NW b N.	Fresh Gales. Wet Fog.
11	35	38	61 49	0 42 E	38 00	N b W to N b E.	Moderate, but cold Air.
12	34	37	62 33	0 51 E	42 00	Obs. N b E to NN W.	Fresh Gales, squally, with Rain.



From D I G G S.

D. M.	Barom. Altitud.	Therm. Altitud.	Lat. North.	Long. West.	Variat. West.	Obs.	Wind.	Weather.
Sep. 13	33	34	53° 20'	10° 20' E	43° 00'	Obs.	All round.	Sometimes calm.
14	32	35	53 03	2 34 E	40 00		S b E to N N W.	Squalls, Showers of Snow and Hail.
15	32	36	52 09	9 19 E	42 00		N W to N N W.	Stormy, frequent Showers of Snow

From B U T T O N 's Islands.

16	33	35	61° 10'	0° 29' E	39° 00'		N b W to N N W.	Many Isles of Ice and Snow.
17	30	34	50 35	6 09	34 00		N W to N.	Fresh Gales, and frequent Squalls.
18	30	34	58 52	10 39	34 00		N N W to N N E.	Squally, with Showers of Snow.
19	30	35	57 54	14 06	32 00		N W.	Squally, with Hail.
20	30	34	57 28	16 15	30 00		N W to S b W.	Squally, with Hail and Rain.
21	31	33	57 38	18 24	28 00		S b W to W S W.	Hard Squalls, some Rain.
22	30	35	56 19	22 27	25 00		W S W to N W.	Stormy, with some Hail.
23	30	36	54 40	27 43	22 30		N W.	An hard Storm, with Hail.
24	29	36	53 28	32 28	21 00		W N W to S S W.	High Winds, with Hail.
25	31	35	53 34	35 16	19 00		S to W S W.	A Storm. Wind and Rain.
26	33	34	52 46	36 27	18 00		W to S W.	More moderate. Fresh Gales, Rain.
27	33	34	52 21	39 11	17 00		S S W to N W.	Squalls of Rain.
28	32	34	50 35	42 10	16 00		N. to W b S.	Frequent Showers of Rain.
29	30	33	50 41	46 23	15 00		S W b W to S S W.	Very squally, with Lightning.
30	32	32	50 07	49 09	14 00		S W.	An hard Gale, with Rain.
Oct. 1	35	31	49 26	51 57	14 00		S W to N N W.	More moderate and fair.
2	30	33	49 30	53 45	14 00		N E.	Moderate and fair. Little Wind.
3	25	30	49 56	54 34	13 00		S E.	Fresh Gales, with Rain.
4	25	30	49 19	54 10	13 00		S to E.	A Storm. Wind and Rain.
5	25	29	49 47	53 50	13 00		E b S.	An hard Storm, with Rain.
6	29	28	50 10	53 26	13 00		E S E.	Stormy, with Thunder.
7	31	27	49 58	53 48	13 00		East.	More moderate. Cloudy. Some Rain.
8	32	29	49 21	55 19	13 00		E to S S W.	Foggy, with some Rain.
9	32	30	49 45	58 49	13 00		W S W to S b W.	Fresh Gales, with Rain.
10	33	28	49 56	61 37	13 00	Obs.	S to S S W.	Fair and moderate for the most Part.

Off Plymouth.

These Observations were made by Mr John Patrick's new Quicksilver Marine Barometer.

Note, The Altitude of the Barometer and Thermometer were taken at Noon. The Account of Wind and Weather at Sea is from Noon to Noon.

XVI. The weighing the Water and reducing it from Weight to Depth seemed pretty troublesome, even when done in the easiest Method: To remedy this Inconvenience (besides a Funnel and proper Receptacle for the Rain) I use a cylindrical Measure and Gage. The Funnel is 30 Inches diameter, and the cylindrical Measure exactly 3 ; the Depth of the Measure is 10 Inches, and the Gage of the same Length, with each Inch divided into 10 equal parts ; or, instead of a Gage, the Inches and Divisions may be mark'd on the Side of the cylindrical Measure. The Apparatus is simple and plain, and it is easy to apprehend the Design and Reason of the Contrivance ; for

*An Account of the Depth of Rain fallen from April 1, 1722, to April 1, 1723. Observed at Widdrington in Northumberland, by the Rev. Mr Horsley. No. 377. P. 328.*



*An Account of the Depth of Rain, &c.*

the Diameter of the cylindrical Measure being just  $\frac{1}{10}$  of that of the Funnel, and the Measure exactly 10 Inches deep, 'tis plain that 10 Measures of Rain make an Inch in Depth; one Measure,  $\frac{1}{10}$ ; one Inch on the Gage,  $\frac{1}{100}$ ; and  $\frac{1}{10}$  of an Inch on the Gage,  $\frac{1}{1000}$ , &c. By this Means the Depth of any particular Quantity which falls, may be set down with Ease and Exactness, and the whole at the End of each Month, or every Year, may be summed up without any Trouble.

By the following Account you'll see, that some of the Summer Months, particularly *May* and *July*, were very wet, and some of the Winter ones very dry; so that, one with another, this Year's Rain, as far as can well be conjectured, may be looked upon as a *Medium*. And if so, it differs not above two or three Inches, from the mean Quantity of Rain which falls at *Upminster*, *Paris*, and *Lisle*, being less than at *Lisle*, and more than at the other two Places.

*An Account of the Depth of Rain fallen from April 1, 1722, to April 1, 1723.*

	Inch.
In April ——— ——— ——— ———	1,015
In May ——— ——— ——— ———	3,532
In June ——— ——— ——— ———	2,570
In July ——— ——— ——— ———	4,350
In August ——— ——— ——— ———	2,132
In September ——— ——— ——— ———	1,155
In October ——— ——— ——— ———	,600
In November ——— ——— ——— ———	2,205
In December ——— ——— ——— ———	1,780
In January ——— ——— ——— ———	1,225
In February ——— ——— ——— ———	,485
In March ——— ——— ——— ———	,195
<hr/>	
In the whole Year ——— ——— ———	21,244
<hr/>	

*The Effects of  
a violent Show-  
er of Rain in  
Yorkshire, by  
Mr Ralph  
Thoresby,  
F. R. S. No.  
372. p. 101.*

XVII. The Effects of a violent Shower of Rain at *Riponden*, near *Halifax*, were so surprizing, that I wrote to a Gentleman in those Parts for an Account that might be depended upon; and particularly desired to know, whether there was not an Eruption of Waters out of the Hills, as the late ingenious Mr *Townley* of *Townley* wrote me there was out of *Pendle-hill*, in that at *Star-bottom* mentioned in the *Philos. Transf.* No 245. but all the Account I can learn of this is, that what they call the Dashing of two great watery Clouds upon the Hills, occasioned the Inundation; whatever was the more immediate Cause,



Cause, the Effects were dismal, and so sudden, that tho' it was upon the Day-time, the poor Creatures could not save their Lives. This Calamity happened the 18th of May, 1722. betwixt the Hours of 3 and 5, when by the modestest Account the Beck was raised two Yards at least in perpendicular Height above what was ever known before; which may be easily conceived by the Situation of the Place implied in the Termination *den*, which signifies a deep Valley between pretty steep Hills on each Side. *Fontes in convallibus*, is in the Saxon Version rendered pillar on denum *Pf. ciiij. 2.* and *Valley of Tears*, (as this now) *Pf. lxxxij. 6.* bene *teopa*. Several Houses, four Mills (some say six), nine Stone-Bridges, and ten or eleven of Wood, are taken down, and the Wheels, Dams, and Sluices, (*Eboracensibus* Goits, from the verbal Noun *geotān fundere*) of most of the Mills that are left standing, broken and damaged; and a great deal of Cloth gone. Fifteen Persons were drowned, of whom *Jonas Longbothorn* and his Servant are not yet found. Seven out of eight in one House were either slain by the Fall of it, or drowned. A young Man escaped by help of a piece of Timber, was turned over and over again, in passing two or three Dams, but at last taken out alive, tho' distracted for the present; but it's hoped he may recover.

The Rapidness of the Torrent was so violent, that it took down the North-side of *Ripponden* Chapel, and carried off most of the Seats. A Man of *Dewsbury* told me, that he saw four of them that were driven to that Town; and the Rector of *Castleford*, who visited me the Day after, informed me, that many Goods were carried down so far, tho' above 20 Miles off. It tore up the Dead out of their Graves; at first I was willing to believe it only of an old Woman that had been buried that Afternoon, and so the Earth not fully settled again; but am since informed, by a sure hand, that two corrupted Corpses were driven upon one Gentleman's Land, and as many upon another's. It swept away all the Corn-Land, as deep as the Plow had gone. Some Persons saved themselves by forcing a Way out of the Roofs of their Houses, and sitting upon the Ridges till the Floods abated.

I was that Day seized by a smart Thunder-Shower, upon the Moor, as I was coming home.

XVIII. On the 30th of *January* last, something past Nine in the Morning, Weather cold, Wind Southwesterly, but not very high, Barometer above thirty Inches, I saw that pretty Phenomenon of the Star-like Snow, and tho', upon comparing my Observations afterwards with those of *Descartes*, *Dr Grew*, and *Mr Morton*, I find I have but little to add upon the Subject; yet, as I observed the Progress of Nature in this sort of CrySTALLIZATION, with a great deal of Pleasure, I hope it will not be disagreeable to you to receive an Account of it.

*Observations on the Figures of Snow. By the Reverend Benj. Langwith, D. D. No. 376. p. 298.*



Fig 3.

I shall begin with the most simple Figures A and B, of which the former is a roundish Pellet of Ice; the second, a small oblong Body, with parallel Sides, which is often as fine as a Hair. Of this latter kind the Flakes of Snow chiefly consist; and tho' they look white to the Eye, yet when viewed with a small Magnifier or a Microscope, they appear like so many transparent Needles of Ice thrown together, without any Manner of Order.

The next Figure is C, in which the Pellet has shot out six of those small Bodies of equal Length, and set at equal Angles: Of this kind I saw a considerable Number.

The next Step in the CrySTALLIZATION is D, in which those Bodies are lengthened, and have shot out a great many more from their Sides, at equal Angles, but unequal Lengths, as growing continually shorter and shorter, till they terminate in a Point: I measured some of these, and found them to be about one quarter of an Inch in Breadth. I saw but very few of them in Perfection, for the collateral Shoots were so exquisitely fine, as to be liable to be broken in their Fall, or confounded together by the least Degree of Heat.

Of the next kind, E, I saw a very great number, which being examined by the Microscope, plainly appeared to be nothing but the former in Disorder. The Edges of these were in general very irregular, but some of them happened to be so indented, as to look like the jagged Leaves of Plants.

The next Kind, F, had twelve points regularly disposed, and probably might consist of two of the former so joined together, as to cut their Angles equally.

Perhaps also those Mr *Morton* describes, as consisting of *Radii*, which, instead of terminating in a Point, grow bigger, as they advance from the Centre, might be formed from two of the Kind, C, so joined at the Centre, as to cut each other's Angles unequally; for in the Progress of the CrySTALLIZATION, these *Radii* would quickly unite.

Lastly, that Sort, which *Descartes* compares to Roses, and of which he has given a Figure in his Treatise of Meteors, may be nothing but the Kind E, when the Points are rounded off, by being gently thawed.

I propose these things only by way of Conjecture; because, as the small Drops of Water may be impregnated with very different Particles in the Air, it is not easy to determine, whether these Figures may not be the Result of a CrySTALLIZATION quite different from the former.

I had almost forgot to tell you, that I saw but very few Figures of twelve Points, and those mostly imperfect in one respect or other.



XIX. Dr *Niewentyt* and some others say — That Particles of Fire separated from the Sun-Beams, by adhering to Particles of Water, make up *Moleculæ*, or small Bodies, specifically lighter than Air, which therefore, by hydrostatical Laws, must rise and form Clouds that remain suspended when they are risen up to such an Height that the Air about them is of the same specifick Gravity with themselves.—

That Rain is produced by the Separation of the Particles of Fire from those of Water, which last being then restored to their former specifick Gravity, can no longer be sustained by the Air, but must fall in Drops. See *Niewentyt's Religious Philosopher*. Contemplation. 19. From Sect. xiii. to Sect. xxv.

*An Attempt to solve the Phenomenon of the Rise of Vapours, Formation of Clouds, and Descent of Rain, by J. T. Desaguliers, L. L. D. F. R. S. No. 407. pag. 6.*

Now this is liable to several Objections, *First*, It is built upon a Supposition that Fire is a particular Substance, or distinct Element, which has never yet been proved by convincing Experiments and sufficient Observations; and which the Reverend Mr *Hales* has in his late excellent Book of *Vegetable Statics* shewn to be an ill grounded Opinion, making it very plain, that in Chymical Operations those Bodies which had been thought to become heavier by Particles of Fire adhering to them, were only so by Adhesion of Particles of Air, &c. which he has shewn to be *absorbed* in great Quantities, by some Bodies, whilst it is *generated* (or reduced from a fixt to an elastic State) by others; nay, that it may be *absorbed* and *generated* successively by the same Body, under different Circumstances.

*Secondly*, If we should allow the above-mentioned Supposition, the Difficulty will still remain about the Production of Rain by the Separation of the Fire from the Water; For Dr *Niewentyt* ascribes this Effect to two different Causes. *First*, to Condensation (*Sect. xxiii.*) saying, “ That when contrary Winds blow against the same Cloud “ and drive the watery Particles together, the Fire that adhered to “ them gets loose, and they (becoming then specifically heavier) “ precipitate and fall down in Rain.” Then in the very next *Sect.* he ascribes it to Rarefaction, when he says, “ That when a Wind “ blowing obliquely upwards causes a Cloud to rise into a thinner Air “ (*i. e.* specifically lighter than it self) the Fire which by sticking to “ the Particles of Water rendered them lighter, extricates itself from “ them, and ascending by it's Lightness, the Water will become too “ heavy, not only to remain in this thin and light Air, but even in “ a thicker and heavier near the Earth, and so will be turned into a “ descending Dew, Mist, or Rain, or Snow, or the like, according “ as the watery Vapours are either rarefied or compressed.”

The first of these Causes of Rain is contrary to Experience; for when two contrary Winds blow against each other over any Place of the Earth, the Barometer always rises, and we have fair Weather. For then (as Dr *Halley* says, in *Philosophical Trans.* N<sup>o</sup> 183) the Air being accumulated above, becomes specifically heavier about the



Clouds, which (instead of falling into Rain, as Dr *Niewentyt* supposes) ascend up into such a Part of the Atmosphere, as has the Air of the same specifick Gravity with themselves.

If the falling of Rain might be attributed to the second of these Causes, then every time a Cloud is encompassed with Air specifically lighter than itself (whether it be when by the blowing away some of the superior Air, that which is about the Cloud becomes rarer as it is less compressed, or by the Cloud being driven upwards) Rain must necessarily follow; whereas one may often see the Clouds rise and fall without Rain, even when the Barometer shews the Weight of the Air to be altered. For that happens only when by the great Diminution of the specifick Gravity of the Air about the Cloud, it has a great Way to fall; in which Case, the Resistance of the Air, which increases as the Square of the Velocity of the descending Cloud, causes the floating Particles of Water to come within the Power of each others Attraction, and form such big Drops, as being specifically heavier than any Air, must fall in Rain.

No gentle Descent of a Cloud, but only an accelerated Motion downwards, produces Rain.

N. B. *I don't mean that the quick Descent of a Cloud is the only Cause of Rain; because the Shock from a Flash of Lightning, and the sudden return of the Air, after the Vacuum made by the Flash, will condense the floating Vapour into Water; and also the same Cloud which in the free Air, might be carried horizontally without being turned into Rain, meeting with an high Hill in it's Way, will be condensed and fall in Drops; especially if, in the Day-time, it be driven by the Wind out of the Sun-shine, against the shaded Side of the Mountain.*

Besides all this, if Particles of Fire were joined with those of Water to raise them up, those igneous Particles must be at least 1000 Times greater in Bulk than the watery ones; so that a Person, who at the Top of a Hill, has his Hands and Face in a Cloud, must feel a very sensible Warmth, by touching a much greater Surface of Fire than Water in the Cloud, and afterwards find the Rain produced from that Vapour sensibly colder; whereas the contrary is proved by our Senses; the Tops of Hills, though in the Clouds, being much colder than the Rain at Bottom.

There is another Opinion concerning the Rise of Vapours, namely, that tho' Water be specifically heavier than Air, yet if it's Surface be increased by very much diminishing the Bulk of it's Particles, when once raised, it cannot easily fall; because the Weight of each Particle diminishes as the Cube Root of it's Diameter, and the Surface to which the Air resists, only as the Square Root of the said Diameter: That we see this in the Dust in Summer, and in Menstruums that sustain Metals dissolved, which are specifically heavier than the Menstruums.

But



But this will not explain the *Phænomenon*; because though the Encrease of Surface (the Weight remaining the same) will in a great Measure hinder (or rather retard) the Descent of small Bodies moving in the Air, by reason of it's great Resistance to so large a Surface; it will for the same Reason also hinder the Ascent. For the Rise of Dust is owing to the Motion of Animals Feet in it, or to the Wind: Whereas Vapours rise in calm Weather, as well as windy; neither do they, like the Dust, always fall to the Ground when the Wind ceases to blow.

The third Opinion, and which is most commonly received, is, that by the Action of the Sun on the Water, small Particles of Water are formed into hollow Spherules filled with an *Aura*, or finer Air highly rarefied, so as to become specifically lighter than common Air, and consequently that they must rise in it by hydrostatical Laws. As for Example, If a Particle of Water, as it becomes a hollow Sphere, be only encreased ten Times in Diameter, it's Bulk will be encreased a thousand Times; therefore it will then be specifically lighter than common Water, whose specifick Gravity is to that of Air, as 850 to 1; then if the Density of the *Aura*, or Spirit within the little Shell, be supposed 9 Times less than that of Air, or as 50 to 850, that specifick Gravity of the Shell, and it's Contents will be to that of Air, as 900 to 1000; therefore such an aqueous Bubble must rise till it comes to an *Æquilibrium* in Air, whose Density is to the Density of that in which it began to rise, as 850 to 945 nearly. But it appears by Experiments, that Air rarefied by an Heat which makes a Retort red hot, is only encreased in Bulk, or dilated 3 Times; by the Heat of boiling Water only  $\frac{10}{14}$  or near two Thirds; and by the Heat of the Human Body (such as will raise Vapours plentifully) only  $\frac{10}{39}$  or about  $\frac{1}{4}$ . I own my Objection may be answered, by supposing the Spherule of Water to be more encreased in Diameter, as for Example 20 times; because then if it be filled with Air only  $\frac{1}{4}$  rarer than common Air, it will be specifically lighter, and capable of rising to a considerable Height.

To give this Solution all it's Force, let us express it in Numbers. Let A and W represent a Particle of Air, and one of Water of equal Bulk, then will the Weight of A be to the Weight of W as 1 to 850, their Bulks being equal. If the Particle of Water be blown up into a Bubble (*w*) of 20 Times it's Diameter, then will it's Bulk be to it's Weight, as 8000 to 850, whilst a Sphere of Air (*a*) of the same Bigness, has it's Weight as well as Bulk equal to 8000: Now if an Air or *Aura*  $\frac{1}{4}$  rarer than common Air be supposed within the watery Bubble to keep it blown, it will be the same as if  $\frac{3}{4}$  of the Air of (*a*) was carried into (*w*) and then the Weight of (*w*) would be encreased by the Number 6000; so that the Shell of Water being in Bulk 8000, would be in Weight  $850 + 6000 = 6850$ , whilst an equal Bulk of Air weighed 8000, and consequently the watery Bubble would rise till



till it came to an Air, whose Density is to the Density of the Air next to the Surface of the exhaling Water as 6850 to 8000.

This is the strongest Way of stating the Hypothesis. But to support it, the following Queries must be answered.

*Query 1st*, How comes the *Aura*, or Air in the Bubbles, to be specifically lighter than the Air without them, since the Sun's Rays, which act upon the Water, are equally dense all over it's Surface?

*Query 2d*, If it could be possible for a rarer Air to be separated from the denser ambient Air, to blow up the Bubbles (as Bubbles of soaped Water are blown up by warm Air from the Lungs, whilst the ambient Air is colder and denser) what would hinder that cold Air by it's greater Pressure, from reducing the Bubbles to a less Bulk, and greater specifick Gravity than the Air, especially since cold can be communicated through such thin Shells, and the Tenacity of common Water is very small when compared to that of soaped Water (whose Bubbles, notwithstanding that Tenacity) are soon destroyed by the Pressure of the outward Air, as the Air within them cools?

*Query 3d*, If we should grant all the rest of the Supposition, yet this Difficulty will remain. If Clouds are made up of hollow Shells of Water filled with Air, why do not those Clouds always expand when the ambient Air is rarefied, and presses less than it did before, and also suffer a Condensation, as the ambient Air is condensed by the Accumulation of the superior Air?

If this Condensation and Rarefaction should happen to the Clouds, they would always continue at the same Height, contrary to Observation; and we should never have any Rain.

*From all this it follows, that the Condensation and Rarefaction of the Vapours, which make Clouds, must depend upon another Principle than the Condensation and Rarefaction of the Air: And that there is such a Principle, I shall endeavour to shew.*

### L E M M A.

*The Particles of all Fluids have a repellent Force.*

Fluids are elastic or unelastic; The elastic Fluids have their Density proportionable to their Compression, and Sir *Isaac Newton* has demonstrated (*Princip. Lib. ii. Sect. v.*) that they consist of Parts that repel each other from their respective Centers. Unelastic Fluids, like Mercury, Water, and other Liquors, are by Experiments found to be incompressible; for Water in the *Florentine Experiment* could not by any Force be compressed into less Room, but oozed like Dew through the Pores of the hollow golden Ball in which it was confined, when a Force was applied to press the Ball out of it's spherical, into a less capacious Figure. Now this Property of Water and other



other Liquors must be intirely owing to the centrifugal Force of it's Parts, and not it's want of Vacuity; since Salts may be imbibed by Water without encreasing it's Bulk, as appears by the Encrease of it's specific Gravity. So Metals, which (singly) have a certain specific Gravity beyond which they cannot be condensed, will yet receive each other in their Interstices so as to make a Compound specifically heavier than the heaviest of them; as is experienced in the Mixture of Copper and Tin.

### SCHOLIUM.

By encreasing the repellent Force of the Particles, an unelastic or incompressible Fluid may become elastic, or a Solid (at least a great Part of it) may be changed into an elastic Fluid; and, *vice versâ*, by diminishing the repellent Force, an elastic Fluid may be reduced to an unelastic Fluid, or to a Solid. That the Particles of Quicksilver, Water, and other Liquors, are likewise endued with an attractive Force, is evident from those Substances running into Drops in an exhausted Receiver, as well as in the Air, and likewise their adhering to other Bodies. The Attraction and Repulsion exert their Forces differently: The Attraction only acts upon the Particles, which are in Contact, or very near it; in which Case it overcomes the Repulsion so far, as to render that Fluid unelastic, which otherwise would be elastic; but it does not wholly destroy the Repulsion of the Parts of the Fluid, because it is on Account of that Repulsion that the Fluid is then incompressible. When by Heat or Fermentation (or any other Cause, if there be any) the Particles are separated from their Contact, the Repulsion grows stronger, and the Particles exert that Force at great Distances, so that the same Body shall be expanded into a very large Space by becoming fluid, and may sometimes take up more than a Million of Times more Room than it did in a solid or incompressible Fluid. (See the *Queries* at the End of Sir Isaac Newton's Optics.) Thus is Water by boiling, and less Degrees of Heat, changed into an elastic Vapour rare enough to rise in Air, Oils and Quicksilver in Distillation made to rise in a very rare Medium, such as remains in the red-hot Retort, and sulphureous Steams will rise even in an exhausted Receiver, as the Matter of the *Aurora Borealis* does in the thinner Part of our Atmosphere. If Aqua-fortis be poured on Quicksilver, a reddish Fume will rise much lighter than common Air; so also will Fumes rise from Filings of Metals, from Vegetables when they ferment by Putrefaction; and (as the Reverend Mr Hales has shewn) several solid Substances by distilling, as well as Fermentation, will generate permanent Air.

That Heat will add Elasticity to Fluids is evident from numberless Experiments, especially from Distilling and Chymistry: But what is needful to consider here is only, that it acts more powerfully on



Water than common Air; for the same Heat which rarefies Air only  $\frac{2}{3}$  will rarefy Water very near 14000 times, changing it into Steam or Vapour as it boils it: And in Winter, that small Degree of Heat, which in Respect to our Bodies appears cold, will raise a Steam or Vapour from Water at the same Time that it condenses Air.

By a great many Observations made by Mr *Henry Beighton*, F.R.S. and myself, upon the Engine to raise Water by Fire, according to Mr *Newcomen's* Improvement of it; we found that the Water in boiling is expanded 14000 times to generate a Steam as strong (*i. e.* as elastic) as common Air, which therefore must be near  $16\frac{1}{2}$  times specifically lighter. And that this Steam is not made of the Air extricated out of the Water is plain, because it is condensed again into Water by a Jet of cold Water spouting in it; and the little Quantity of Air that comes out of the injected Water must be discharged at every Stroke, otherwise the Engine will not work well. There is also another Experiment to confirm this.

### EXPERIMENT.

Fig. 5.

A B C D is a pretty large Vessel of Water, which must be set upon the Fire to boil. In this Vessel must be suspended the glass Bell E, made heavy enough to sink in Water; but put in, in such a Manner that it be filled with Water when upright, without any Bubbles of Air at it's Crown within, the Crown being all under Water. As the Water boils, the Bell will by Degrees be emptied of it's Water, being pressed down by the Steam which rises above the Water in the Bell; but as that Steam has the Appearance of Air, in order to know whether it be Air or not, take the Vessel off the Fire, and draw up the Bell by a String fastened to it's Knob at Top, till only the Mouth remains under Water; then, as the Steam condenses by the cold Air on the outside of the Bell, the Water will rise up into the Bell at F quite to the Top, without any Bubble above it, which shews that the Steam which kept out the Water was not Air.

N. B. *This Experiment succeeds best when the Water has been first purged of Air by boiling, and the Air-Pump*

We know by several Experiments made on the Fire-Engine (in Captain *Savery's* Way, where the Steam is made to press immediately on the Water) that Steam will drive away Air, and that in Proportion to it's Heat; though in the open Air it floats and rises in it like Smoak.

Now if the Particles of Water turned into Steam or Vapour repel each other strongly, and repel Air more than they repel each other; Aggregates of such Particles made up of Vapour and Vacuity may rise in Air of different Densities, according to their own Density dependant on their Degree of Heat, without having Recourse to imaginary Bubbles formed in a Manner only supposed, and not proved, as we



we have already shewn. I own indeed, that if the watery Particles had no repellent Force, they must precipitate in the same Manner that Dust will do after it has been raised up; but we have too many Observations and Experiments to leave any Doubt of the Existence of the repellent Force above-mentioned. Neither can I shew by any Experiment, how big the Molecularæ of Vapour must be which exclude Air from their Interstices, and whether those Molecularæ do vary in Proportion to the Degree of Heat by an Increase of repellent Force in each watery Particle, or by a farther Division of the Particles into other Particles still less; but in general we may reasonably affirm, that the Rarity of the Vapour is proportionable to the Degree of it's Heat, as it happens in other Fluids (See Phil. Transact. Numb. 270.) and that, though the different Degrees of the Air's Rarefaction are also proportionable to the Heat, the same Degree of Heat rarefies Vapour much more than Air.

Now to shew, that what has been said will account for the Rise of Vapours and Formation of Clouds, we must only consider; — whether that Degree of Heat, which is known to rarefy Water 14000 \* Times, being compared with several of those Degrees of Heat in Summer, Autumn, and Winter, which are capable of raising Exhalations from Water or Ice; the Rarity of the Vapours (estimated by the Degree of Heat) will appear to be such, that the Vapour will rise high enough in Winter, and not too high in Summer, to agree with the known Phænomena.

That the Effects are adequate to the Causes in this Case, I think I can make out in the following Manner, viz.

The Heat of boiling Water, according to Sir Isaac Newton's Table (Phil. Transact. Numb. 270) is 34, the mean Heat of Summer 5, the mean Heat of Spring or Autumn 3, and the least Degree of Heat, at which Vapours rise in Winter (*alias* the mean Heat of Winter) is 2. The Rarity of Vapour proportionable to these four Degrees of Heat, is 14000, 2058, 1235, and 823. The Rarity of Air is, in Summer 900, in Spring or Autumn 850, and in Winter 800, the Density of Water compared with the above-mentioned Densities, being inversely as One to the said fore-mentioned four Numbers. The Heights above the Earth to which the Vapours will rise, and at which they will be in *æquilibrio*, in an Air of the same Density with themselves, will vary according to the Rarity of the Vapour depending on the Heat of the Season. For the Vapour which is raised by the Winter's Heat, expressed by the Number 2, when the Air's Rarity

\* As the Digression would be too long to mention here those Observations on the Fire-Engine, which shew that the Vapour from boiling Water is expanded 14000 Times more than cold Water; I refer the Reader to the 6th Section of 25th Contemplation of Nieuwentyt's Religious Philosopher, where he proves by an Experiment made with an *Æolipile*, that one Inch of Water produces 13365 Inches of Vapour; which, considering the great Allowances made against the Assertion, may well be called 14000.



is 800, will rise to (and settle at) a Height of about the Sixth of a Mile, when the Barometer is above 30 Inches high. But if the Heat be greater then, the Vapours will rise higher, and pretty much higher if the Sun shines, though in frosty Weather, the Barometer being then very high. If the Barometer falls, and thereby brings the Place of *Æquilibrium* (for Vapours raised by the Heat 2) nearer the Earth, then also will the Heat be encreased, the Vapour more rarefied, and consequently the new Place of *Æquilibrium* sufficiently high. It is to be observed, that in Winter, when the Heat is only equal to 2, the Air is densest close to the Earth, which has not any Heat sufficient to rarefy it near the Ground, as happens in warm Weather; therefore the Vapour will rise gradually in an Air whose Density decreases continually from the Earth upwards; neither will the Vapour be hindered of it's full Rise, by any Condensation from a greater Cold of the ambient Air, the Air being then as cold next to the Ground where the Vapour begins to rise, as it is at any Height from the Earth.

The Vapour which is raised by the Heat of Spring or Autumn expressed by Number 3, will rise to the Height of  $3\frac{1}{2}$  Miles, when the Barometer is at 30, and the Air's Rarity is 850. But then, as the Air is hotter nearer the Ground than at the Height of half a Mile or a Mile, the Vapour will condense as it rises; and as the Air, when the Earth is heated, is rarer near the Ground than at some Height from it, the Place of *Æquilibrium* for Vapour will, upon these two Accounts, be brought much lower than otherwise it would be; as for Example, to the Height of about a Mile, which will agree with *Phænomena*.

In Summer, the two Causes above-mentioned encreasing, the Vapour raised by the Heat 5 (whose Place of *Æquilibrium* would be  $5\frac{1}{2}$  Miles high, if the Vapour after it began to rise was not condensed by cooling, and the Air was densest close to the Earth) will settle at the Height of about  $1\frac{1}{2}$  or 2 Miles, which is also agreeable to *Phænomena*.

Lastly, As the Density and Rarity of the Vapour is chiefly owing to it's Degree of Heat, and in a small Measure to the encreased or diminished Pressure of the circumambient Air, when it is not confined; and the Density and Rarity of the Air is chiefly owing to the increased or diminished Pressure, by the Accumulation or Exhaustion of superior Air, whilst Heat and Cold alter it's Density in a much less Proportion; the Clouds made of the Vapours above-mentioned, instead of conforming themselves to the altered Density of the ambient Air, will rise when it is condensed, and sink when it is rarefied; and also rise or sink (when the Pressure of the Air is not altered, and it's Density very little changed) by their own Dilatation, owing to Heat or Cold; as may be observed often, by seeing them change their Height considerably, whilst the Barometer continues exactly



exactly at the same Degree, and the Thermometer's Liquor rises or falls very little, and sometimes not at all.

As for the Manner how Clouds are changed into Rain, I have hinted it in the Beginning of this Paper; but for farther Satisfaction, I refer the Reader to Dr *Halley's* Account of it, in the *Philosophical Transactions* (Numb. 183.) in which I entirely acquiesce, having always found it agreeable to the *Phænomena*.

If by publishing these Thoughts, I have explained the Rise of Vapours, in a more satisfactory Way than has been done before; or if I have only given useful Hints to others more capable of doing it, I have my End.

P. S. Since I have, for Brevity sake, only mentioned at what Heights from the Surface of the Earth, Vapours of different Densities will come to an *Æquilibrium*, without giving a Reason for settling the Place of *Æquilibrium*, at those Heights; I think proper to give the Method here by which they are to be found, *viz.* As the Vapours will settle and rise where the Air is of the same Density with themselves; it is only required to find the Density of the Air at any Distance from the Earth, at several Heights of the Barometer, which may be deduced from Dr *Halley's* two Tables, *Philosoph. Transact.* Numb. 386. (the First shewing the Altitude to given Heights of the Mercury; and the Second, the Heights of the Mercury at given Altitudes) and knowing the Degree of Heat by the Thermometer, because the Density of the Vapour depends upon the Degree of Heat of the Season; provided that proper Allowances be made for the great Rarefaction of the Air near the Earth in hot and dry Weather, and the Condensation of the Vapours in their Rise, by reason of the Air being colder at a little Height above the Earth than just at the Surface of it.

XX. In the *Philosophical Transactions* for November and December, 1709, N. 324, I have given an Account of some of the most remarkable Frosts that I could find any Relation of; and particularly of that great and, I had almost said, universal one in 1708, which the Society had very good Histories of from divers Parts, and which, in that *Transaction*, I have given an Account of from the Original Papers, which the Society was pleased to do me the Honour to entrust me with.

Concerning the  
FROST in  
January 1731.  
By the Rev.  
William Der-  
ham, D. D.  
No. 417. pag.  
16.

In that *Transaction* I have made it very probable, that the greatest Descent of the Spirits in the Thermometer, was on *Decem.* 30, 1708, when my Glass was within  $\frac{1}{10}$  of an Inch as low as it is with artificial Freezing with Snow or Ice and Salt: And in the late Frost it was almost, if not altogether, as low.

The *Freezing-Point* of my Thermometer is 10 Inches (which I call 100 Degrees) above the Globe of Spirits; and the most intense Freezing (according to the Methods I have mentioned in that *Transaction*) is just at, or very little within, the Ball. And on January 30, about

Sun-



Sun-rising, the Thermometer was but an Inch, or 10 Degrees above the Point of extreme Freezing; and on *February 3*, at only half an Inch, or 5 Degrees. And considering that the Thermometer I observed with in 1708, was less accurate, and differently graduated from that which I now have, I am apt to think, that the Frost on *February 3* last, was altogether as intense as that on *December 30*, 1708. For although a frigorifick Mixture sunk the Spirits but one Tenth lower in the old Thermometer, and about 5 or 6 Tenths in that I now observe with, yet I take the Difference to be little, or none at all, by reason of the Tendernefs of the new above the old Glafs.

And this Degree of Cold I take to be as excessive as in any of the Years mentioned in the said *Transaction*; yea, any of the Years, when the *Thames* at *London* was frozen over: I am sure colder than in the Year 1716, when that River was frozen over for several Miles, and Booths and Streets were made on the Ice, an Ox roasted thereon, &c. For the lowest Point of Freezing in 1716, was on *January 7*, when the Spirits fell to 35 Degrees only of the Glafs I now make use: But the true Cause of the freezing of the *Thames* that Year was not barely the Excess of the Cold, but the long Continuance of it: Which was also the principal Cause of those remarkable Congelations of that River in 1683, and 1708, when I saw Coaches driven over the Ice, large Fires made on it, &c.

*Effects of  
Lightening,  
by the Rev.  
Mr Jos. Wasse,  
No. 390. pag.  
366.*

XXI. 1. We are told by Mr *Jessop*, in the *Transactions*, that what the common People call *Fairy Circles*, are occasioned by Lightening; but I think it has not yet been observed, that they continue visible 50 Years, and that no Composition of Use in Fire-works will produce near so lasting an Effect, as I have experienced. There seems to be something here, which Sulphur and Nitre will hardly account for. Does it depend upon the great Quantity of the Matter discharged, or the Violence with which it is impelled? The Ground is no way torn up, and the Grass is only a little blasted; which would make one think it's Force well nigh spent: Whereas, when the Burst is near us, the Effect is like that of a Petard, as appears from the following Instance.

On *Saturday July 3*, at *Mixbury*, three Miles *East* of this Place, about two in the Afternoon, *William Hall*, aged above Sixty, was found dead in a hard gravelly Field, together with five Sheep, which lay round him about 30 Yards Distance: of the five, that only, which lay nearest him, had a visible Wound through the Head. The Shepherd lay partly upon his Side; the upper Part of his Head was terribly fractured, and his right Knee was out of joint. He had a Wound in the Sole of his Foot, towards the Heel; his right Ear was cut off, and beaten into his Skull, and Blood flow'd out of that Part upon the Ground. He is supposed to have been driving those Sheep.



Sheep. All his Cloaths and Shirt were torn into small Pieces, and hung about him; but from the Girdle downwards were carried away intirely, and scattered up and down the Field: Particularly, the Soles of a new strong Pair of Shoes were rent off. His Hat was driven to Pieces: I have a Hand breadth of it full of irregular Slits, and, in some few Places, cut as with a very sharp Pen-knife, and a little singed in the upper Part. His Beard, and the Hair of his Head were, for the most Part, close burnt off. The Iron Buckle of his Belt was thrown 40 Yards off, and a Knife in the right side Pocket of his Breeches was broken in Pieces, not melted, and the Haft split. Near each Foot appear two round Holes about a Yard deep, and five Inches Diameter, which shews the Force of the Blow. I have seen an Iron Ball shot out of a Mortar almost perpendicular, which, upon a like gravelly Soil, made not a greater Impression. About the Time this Accident happened, a Tradesman of the same Town observed a Sort of Fire-ball, as large as a Man's Head, to burst in four Pieces near the Church. The Storm began here at 1<sup>h</sup> 30', and lasted, with intermissions, to 2<sup>h</sup> 30', and we saw the Lightning towards *Aylesbury* all the Evening. Two Persons at *Aynho* were a little hurt at the same Time, and one of them struck down to the Ground, and says, he thought he was felled with a Beetle. I my self heard the Hiss of a Ball of Fire, almost as big as the Moon, which flew over my Garden, from S. E. to N. W.

2. I thought I had been impertinently circumstantial in the Account of the late Storm; but there still remains a Particular or two to complete it. I ordered my Nephew, a Student of *Merton*, a pretty good Philosopher, to search the Holes made by the Blast. Both of them at first, were almost perpendicular for half a Yard, and after that grew narrower; in both of them, the Matter divided into two Parts, and formed horizontal Cavities about three Inches Diameter. In one he found a very hard glazed Stone, of about 10 Inches long, 6 wide, and 4 in Thickness, crack'd in two: Others it could not pierce, but was turned here and there out of its Course, but left not the least Blackness, or other Discolouring any where. As to the Knife, it was not the Blade, but the Haft, and the Hinge that goes into it, which was shivered in Pieces. Near the Sheep that was wounded, the Ground was torn up near two Yards round. It was very surprizing, that the Man's Body was not beaten to Pieces, or Bones broken at least.

*A farther account, by the same. ibid. p. 368.*

To make a gross Estimate of the Force, I took a *Coborn* charged with three Quarters of a Pound of very good Powder, wadded with thick Paper, and fired it against a Stone of the same Dimensions, but not so hard, which it shattered to Pieces at half an Inch Distance: But, in the other Blow, we have above treble the Effect, without any discoverable Particles at all; and yet it seems to fly like small Shot; pierces only here and there, and leaves a good many Places

quite



quite untouched, as is evident from the Hat which I have by me. To confirm this, *James Marshal* of this Town assures me, that in the Middle of the same Storm, he received a Blow upon his Hat, which rattled like Shot through the Branches of a Tree: It beat in the Crown a little without penetrating it: He staggered, and was giddy for two Days afterwards. Two of his Sons were, at the same Instant, both knocked down to the Ground, and stunned a little, but presently came to themselves, and have no Wound: They are about 20, and 23 Years old. *Qu.* Whether this may not be accounted for, by supposing the Flame to rarify the Air, and make a Sort of *Vacuum* about one; into which when it returns again, it gives the Likeness of a Stroke with a Beetle, as he expresses it. I fancy a Wind-Gun, with compressed Air, would have the same Effect, and might easily be tryed upon a Dog, or such like Animal.

At Worcester,  
June 11,  
1724. communicated by  
R. Beard,  
M.D. F.R.S.  
No. 394. Pag.  
118.

3. We had on the 10th continued Lightning in the *East* from Eight of the Clock at Night to Twelve; the Weather for some time before having been very sultry, the Wind at N. E. and the Barometer at settled Fair. The next Morning the Mercury sunk, and the Sky became more cloudy and temperate, except a few hot Gleams; at Two in the Afternoon, several fierce Showers fell, attended with Flashes of Lightning and Claps of Thunder, that still approached nearer us: Between Two and Three, a Flash came so violently upon me, succeeded so very quick by a low, unusual, dreadful Sound, that I immediately went to the door, fearing some Mischief near. I was soon call'd to an Officer's Lady (aged about 18, and breeding) kill'd by it in the adjoining Street. I found her yet warm, and that she had survived the Stroke for 6 or 7 Minutes. The Fire-Marks they shewed me were Streaks of a Copper-Colour branched from the Left Shoulder all-over the *Thorax*, and interspersed here and there with irregular Spots, which gave occasion for that Conceit publish'd in our News, that *curious Plants were drawn on her Bosom, as with the finest Pencil*. This sad Accident happened in a Parlour-Window next the Street, that could contain about two Persons. The Lady, it seems, terrified with the repeated Lightning and Thunder, (it having formerly been fatal to her Brother) desir'd an Officer to change Places with her, that she might be near her Husband; but she was no sooner seated by his side, than she inclined side-ways, and spoke some Words; after she was carried to another Room, she said, she was gone, and then, that she was blind, and asked for Water. The Husband was thrown along, together with the fortunate Gentleman that had just resigned his Seat; and a large Looking-Glass was lifted off the Hooks. The Landlord's Daughter, at work near the Lady, perceived such an Impulse on the side of her Head, that her Hearing was much impaired, and upon every Peal of Thunder since she is affected in like manner, tho' not so strongly. The Gentleman complained, that they were stupified, forced down they did not know why, unless it were



were for want of Breath; and of Pains and Numbness in their Limbs. They had likewise on different Parts of their Bodies such reddish Wheals as were seen on the Lady's Breast: But these Symptoms vanished the next Day. The other two Persons at the further End of the Room were untouched; they were all sensible of a sulphurous Smell. The Pane of Glass exactly behind the Lady's Waist, was perforated by a round Hole of an Inch and half Diameter, as if done with a Diamond, or rather a Wind-Gun; but no where thereabouts could I discern the least Traces of Fire, or Heat, nor on the Lady's Clothes (having no Stays on) the Signs of any Violence. On a more nice Examination of the Body, in the Presence of the Friends, that Evening, I discovered on the left Loin, taking in part of the Spine of the *Os Ilium*, which was somewhat swoln, a deep Contusion of the same Dimension with the Breach in the Glass: The Skin was neither indurated, nor pierced: The Blood in the Capillaries all round, but chiefly up the Back, settled, the Colour of which was easily distinguished from that of the Streaks, and the circular Impression.

The *Phænomenon*, that caused this Misfortune, rose from the N.E. first slid off the Gabel-Beam, and the Bricks on the back part of the next House, filled a little Court with Flame and Smoak, then turned a Leaden Spout contrary to it's former Direction, mounted over the Roof, and, cracking a Stack of Chimneys, dropt down at the Window where the Husband and Wife sat. Some credible People that saw it, to their great Terror, assure me, that it was a Ball of Fire, and that it burst with the loudest Report they ever heard; and then, with a hissing Noise, passed about a Yard from the Ground through an adjacent Street, and rolled off to the S. W. Some Workmen there, and on a neighbouring Hill, observed the same.

In my Opinion, the Mortality of this Blow may be accounted for from the known Effects of imprisoned Air only, when set at liberty, as the Appearances on the Skin may, from other active Particles hurried along with it at the time of the Explosion. The *Impetus* being first received on the Parts described, occasioned her Death to be less sudden than usual in such Cases.

4. We have had more Lightning and Thunder lately in one week, *A farther ac-  
count by the  
same. No. 394.  
pag. 120.* than ever has been known in that space of time: And what was more extraordinary, the Continuance of it for 9 or 10 Hours together, with little or no Intermission, and at such a Height above us. So far has this been from doing any great Damage near us, that in the Opinion of the Country-Farmers, it had very good Effects, especially at the beginning during the Heat: For the little Insects, that in some Places threatened the Destruction of the Hops and some other Plants, fell off like Bees by the Steam of a lighted Match.



In Carmar-  
thenshire; by  
Mr Evan Da-  
vies, No.  
416. pag. 444.

5. On *December 6, 1729*, in the Afternoon, there happened terrible Thunder and Lightning, which alarmed the whole Neighbourhood; and about four of the Clock or thereabouts, as the Wife of one *William Griff. Morgan* of *Pencarreg*, was carrying a Pail of Water into the House, she was no sooner come over the Threshold into a small Entry that leads towards the Fire, than there broke such a violent Clap of Thunder, after its Forerunner (Lightening) that she and three of her Children were instantly bereaved of their Senses, and lay (they know not how long) miserable and ghastly Monuments of the terrible Shock; and (if my Memory fails me not) they lay weltring in their Blood, before they recovered, and were able to creep to the Bed, 'till the next Neighbour happened to come in (the Husband being then abroad at his Day-Labour) to assist them. The Cause, whatever it was, whether Thunder-Bolt, Thunder-Ball, Lightning, &c. struck ('tis imagined) at the *East End*, near the Foundation, into the Hearth, and cleaved in two a thick Stone of about half a Yard in Breadth beyond the Fire (which we commonly call in *Welsh Pentan*) one Part whereof still remains, and that cleft, but the other is shattered into small Particles and Splinters, and those shot into their Flesh, which ('tis presumed) did the most Hurt. About twenty-four or more of those Stones were from Time to Time taken out of their Wounds; two of those, being all I could get, I have sent for an Instance. It appears, that afterwards it forced it's Way out through the Wall on the *South-side* within the Compass of the Hearth, when it made a terrible Breach from Top to Bottom, and removed the Stones from the Foundation, and nigh thereto made a deep Hole perpendicular in the Earth, that one might thrust in a Staff to the Wrist, as the Woman herself informed me. That part of the Wall was made up before I viewed the Spot. By the Violence of it, the Brand-Irons and Legs thereof were strained, and when they endeavoured to put them to their true Position as before, they found them so burnt up, that they fell a-sunder like rusty Iron, or Wormeaten Timber, and so became of no further Use. The Partitions in the House, which were of no strong Substance (being walled, such as they have in Country Houses) were moved out of place, and a Chest full of Corn forced down towards the Door, some Yards from the Place where it stood. The Bucket the Woman had in her Hand, and other wooden Vessels in the House, were all or most of them shattered, Dishes and Spoons, &c. blown off, and after some Days, found and gathered in the Garden, on the *North-side* of the House, split and broken, with some Yarn that was hanging in the Top of the House, found out of Doors a while after; and many more Disorders than I am able to account for at present.

The Woman has quite lost her left Eye, she was speechless for a Week or nine Days, and could not swallow. She has lately had a few Stones come out of her Mouth, under the Tongue, and o-  
ther



ther Parts inwardly: The Tip of her Tongue is taken off, as far as I can guess, for she is still lisping; three of the fore Teeth of the under Jaw are broken, and the lower Lip is slit, but is now pretty well healed; the second and third Fingers of the Right-hand are quite off, and the Colour of that Hand is still like a Flame of Fire, as if there were yet remaining some igneous Particles in it. She has such a terrible Gash upon that Shoulder between the Joints, that once one might cover an Egg in it, very painful; besides three or more Bruises upon the Arm down to the Wrist, that she is not able to heave or lift it up, without the Help of the other Hand, besides several other Wounds and Bruises over great Part of her Body. A Boy (an Idiot) had his Hair all singed, his Face and Breast all scorched with Blisters like Bladders running from the raw Flesh, with several Stones taken out from his Body and Legs, and two other small Children suffered greatly; so that the Wounds are reckoned by the Woman that used to dress them, to be Thirty at least between the Mother and Children: only one Girl about ten Years old, or thereabouts, that stood at a Distance next the Doors escaped, having her Cloaths only singed, and no Hurt done her. I had almost forgot to mention the several Splinters of Bones taken out in dressing their Wounds, that I could not get. It is worth observing also, that they did smell so strong of the Sulphur and bituminous Matter for some Days, that one could hardly go near them. They are now, free from any grievous Pain so that they go about.

This Account was sent me by Mr *Jenkin Jenkins* a Clergyman, who lives in that Neighbourhood: About half a Year after I was that Way, and viewed the Breach made in the House, and the Wounds which the Woman and her Children had received by the Stones lodged in their Bodies, some of which were not then healed. The Woman then gave me the little Piece of a Stone, wrapped up in the brown Paper, which she said she had taken out of her Tongue, above five Months after this Disaster had happened.

XXII. 1. The 26th of *October*, being on the River coming up to *London*, about half an Hour past Ten, the Sun being then about twenty Degrees high, I observed a Circle about the Sun, which is by no means unusual, when the Air in chilly Weather, such as it is now, is replete with snowy Particles; which Circle was of the Size in which it always appears about 23 Degrees from the Sun, and faintly ting'd with the Colours of the *Iris*. When this Circle happens, I always look out, to see whether any other of the *Phenomena* that sometimes attend it do at that Time appear, such as *Parhelia*, and other coloured Circles, concentric with the Sun, and sometimes, as once I saw it, excentric; as also a white Circle round the *Zenith*, in equal Altitude with the Sun: But this Time, the Air being thickned with a hazy Vapour, and the Smoke of the Town, I could only see to the *Eastward* a luminous white Patch, which for about

*A Parhelion,*  
by Edmund  
Halley *L.L.D.*  
*R. S. S. No.*  
369. pag.  
211.



twenty Minutes shone through the thick Air very conspicuously, of about two Degrees Diameter, as near as I could estimate it, and about the same Altitude with the Sun: and from it, towards the Sun, there seemed to proceed a long white Tail, much narrower than the Mock-Sun, but which I took to be a Segment of the white Circle which I once saw entire in *London*. Had the Air been clear, I doubt not but much more of the *Phenomena* of the *Parhelia* might this Time have been observed: and I hope, that from our Neighbourhood some Member of the *Society* may furnish us with a fuller Relation. But how to explain these Appearances, and account for the Magnitude of these Circles, is what seems still wanting.

Two Parhelia,  
and an Arc of  
a Rainbow  
inverted, with  
a Halo, and  
it's brightest  
Arc, by the  
Rev. Mr  
William  
Whiston.  
M. A. No.  
369. pag.  
212.

Fig 6,

2. About Ten of the Clock in the Morning, on *Sunday October 22. 1722.* being at the House of *Samuel Barker, Esq;* of *Lyndon* in the County of *Rutland*, after an *Aurora Borealis* the Night before (Wind W. S. W.) I saw an Attempt towards two Mock-Suns, as I had done sometimes formerly, of which I immediately informed *Mr Barker*, though without any great Expectations of what followed: About  $\frac{1}{2}$  or  $\frac{3}{4}$  of an Hour after, I went to view the Heavens, and then found the Appearance compleat; and when *Mr Barker* and others of the Family were called, we all saw it; and all saw indeed what we had none of us seen before; I mean two plain *Parhelia*, or Mock-Suns, tolerably bright and distinct; and that in the usual Places, viz. in the two Intersections of a strong and large Portion of an *Halo*, with an imaginary Circle, parallel to the Horizon, passing through the true Sun. I call this Circle here *imaginary*, because it was not it self visible, as it sometimes has been at such Appearances. Each *Parbelion* had it's Tail, of a white Colour, and in direct Opposition to the true Sun; that towards the *East* was 20 or 25 Degrees long; towards the *West* about 10 or 12 Degrees; but both narrowest at the remote Ends. The Mock-Suns were evidently red towards the Sun, but pale or whitish at the opposite Sides, as was the *Halo* also. Upon casting our Eyes upward, we saw an Arc of a curious inverted *Rainbow*, about the Middle of the Distance between the Top of the *Halo* and our *Vertex*. I mean this, when Allowance is made for the usual Inequality, that appears between the same Number of Degrees, nearer to and remoter from that *Vertex*. This Arc was as distinct in it's Colours as the common *Rainbow*; and, with the like Allowance as before, of the same Breadth. The red Colour was on the Convex, and the blue on the Concave of the Arc; which seemed to be about 90 Degrees long: It's Center in or near our *Vertex*. On the Top of the *Halo* was a kind of inverted bright Arc, though it's Bend was not plain. The lower Part of the *Halo* was among the Vapours of the Horizon, and not visible. The Angles, especially as more exactly measured on *Monday*, near Noon, when the same Appearance returned again, but more faintly, were as follows, Sun's Altitude  $22^{\circ}\frac{1}{3}$ ; perpendicular Semidiameter of the *Halo*  $23^{\circ}\frac{1}{3}$ ; Distance



stance of the *Rainbow* from the Top of the *Halo*  $23^{\circ}\frac{1}{2}$ ; Semidiameter of the Arc of the *Rainbow*, if our *Vertex* be supposed it's Center,  $12^{\circ}$ . The *Phænomenon* lasted each Day for an Hour and an half, or two Hours. What was most remarkable on *Monday* was that the Wind, which on *Sunday* had been almost insensible, was now become sensible, and changed to N. N. E. that the *Halo* was sensibly become *oval*; it's shorter Axis parallel to the Horizon; and the two Mock-Suns, which were then but just visible, especially that on the *East*, were not in the *Halo*, but a Degree or two without it, which I ascribe to the unusual Shortness of the Horizontal Diameter; which Position of the Mock-Suns, does not appear to have been hitherto taken Notice of by any, though it was now very sensible.

On *Thursday* Morning, *Octob.* 26. as I was coming in the *Northampton* Coach towards *London*, about 9 of the Clock, the *Halo* returned larger and clearer than before; and the two Mock-Suns just attempted an Appearance therein, as on *Sunday*; but the Air becoming thicker and thicker towards Rain, I saw them no more. I add nothing to this Account, but only, that *Aug.* 30. before, I saw at the same Place (*Rutland*) a remarkable *Halo*, whose upper Part had it's inverted Arc reddish within, and pale without, but brighter and more vivid than ever I saw in my Life: That we had there, *Sept.* 11. in the Evening, the lightest and most remarkable *Aurora Borealis*, with it's unaccountable Motions and Removals, that ever I saw; excepting that original one. *March* 6, 171 $\frac{1}{2}$ : That it was seen in *Northamptonshire*, at the *Bath*, and elsewhere: That the *Vertex* of the Columns which shot upwards, was not our *Vertex*, but evidently 15 or 20 Degrees distant towards the South; and that the Wind was in *Rutland* North, as I observed myself; at the *Bath*, West, as Mr *Molyneux* observed; and, as I am informed by Sir *Robert Clarke*, in *Northamptonshire* South; at all the same Time, which deserves particular Reflexion.

3. *March* 22. 172 $\frac{1}{2}$ , about half an Hour after 5 in the Afternoon nearly, I saw a distinguishable *Parhelion*, the Sun near West, about an Hour high, the Wind and Carry of the Clouds, about N. and by E. the Sky in several Places obscured with light Clouds, and the Sun entering into one somewhat more watery, yet so as to distinguish it's Disk. At first appeared below the Sun, breaking out of the Cloud, such Rays as are usually seen in an Evening, in a Sky interspersed with Clouds. In a little Time appeared at the same Height with the Sun, as near as I could guess, having no Instrument; a luminous Spot, being about four Times the largeness of the Sun's Disk; and about 30 Deg. distant from the Sun to the Southward, which was covered with the lively Shades of red and yellow on the Side next the Sun, and increased in Splendor (so as scarce to be born by the naked Eye) till it exceeded the Brightness of the Sun, which was then under a thin Cloud, so as easily to perceive his Disk. After this had appeared about 3 or 4 Minutes, I finding it to be a real *Parhelion*, began to look about

—in Ireland, by Arthur Dobbs Esq; No. 372. pag. 89.



about for the *Halo* they generally appear in; and as I observed some Rays resembling a Glory to point upwards from the Sun, I saw in those Rays at the same Distance (being, as near as I could guess, about 30 Deg. perpendicularly above the Sun) the Colours of the *Halo* appearing as in the luminous Spot; but instead of finding it, as I expected, in a Circle furrounding the Sun, it was inverted, yet not circular, but making an obtuse Angle, the point towards the Sun. I then looked to the Northward of the Sun, and as the Cloud, which was thicker on that side, moved southwardly, a luminous Spot began to appear at the same Distance from the Sun as the other, and in the same Parallel of Altitude, which had the same Colours towards the Sun, and increased in Brightness, but did not come up to the Brightness of the other Spot, yet was as luminous as the Sun then appeared: this Spot was very little bigger than the Sun's Disk. As the Cloud mov'd on, till it came to about 60 Deg. to the Southward of the Sun and 30 Deg. from the Spot, at an equal Height there appeared another Spot tinged with the Colours of the Rainbow. The whole Appearance lasted a Quarter of an Hour. The Reason of my not seeing the *Halo's*, which generally appear with them, was, that there was a good deal of clear Sky above the Sun, and the Cloud was too thick below it.

Fig. 7.

- A. The Place of the Sun, being nearly *West* about 12 or 13 Deg. above the Horizon, being about an Hour before Sun-set.
- B. The luminous Spot, being about 30 Deg. to the Southward, of the Sun, as near as I could compute, having no Instrument to take the Angle, and in the same Parallel of Altitude; the Spot was not so well defined as in the Scheme, being more imperceptibly shaded off in the Cloud, the two semicircular Lines next the Sun were those tinged with the Colours; the nearest the Sun being of a deep scarlet, the inner one a deep yellow, both the Colours being softened as they fell off from the Sun, all the rest of the Spot being an intense Light, so as the naked Eye could scarce bear it.
- C. The other Spot to the Northward, which appeared some time after that marked B, being not quite so large, nor the Colours so intense, but the same way disposed, those next the Sun being red, the next yellow, and the rest white.
- D. A Spot in the Cloud, as it moved southwardly, till it came to about 60 Deg. Distance from the Sun, which had the Colours as in the other Spots, that next the Sun being red, the next yellow, but much fainter than in the *Parhelia*.
- E. The Appearance of two Segments of Circles, at about the same Distance from the Sun, as the *Parhelia*, being perpendicularly above it, the Colours being fainter than in the *Parhelia*, but the same Way disposed, the lower Lines next the Sun expressing the red, and the upper the yellow.



The Colours at D, and E, as they were not so intense, neither were they quite so broad as those at B and C; the two Colours being added together were about  $\frac{1}{4}$  of the Disk at B, and the Colours in the same Proportion at C; the Diameter of the *Parhelion* at B, being about double the apparent Diameter of the Sun, as near as I could compute, as in the Scheme is expressed.

The Centres of the Segments of the *Halo's* marked E, if not in the *Parbelia*, were very little below 'em.

Below the *Sun* and *Parbelia* the Cloud was too thick to discover any thing thro' it; and above them, till near the Segments marked E, the Sky was serene and nothing obscured; but at E, where the Rays, which pointed upwards from the Sun, terminated, it appeared hazy, and so thick as to reflect the Colours.

4. On *Wednesday, March 1st, 17<sup>26</sup>*, walking in a Garden at *Ken-* Four seen at  
Kensington by  
Mr G. Whi-  
ston, No. 398?  
pag. 257.  
*sington*, about a quarter after Ten I happened to observe the following Appearance.

I at first took notice of the *Halo* about the Sun, V. M. with its usual Circumstances, which are pretty frequent; the upper part of it was very luminous, having a confused mixture of the Rainbow-Colours in it, and being touch'd at the *Vertex* with the two other Curvatures, OVR, NVT, in the Situation which the Scheme shews; tho' Fig. 8. the latter Arch NVT, did not appear till some time after. The Bottom part of it also at M, which appeared a little above the Horizon, had something of the same nature, but not in so great a degree.

I perceived, presently likewise, the two *Parbelia*, A, B; whose Diameters were pretty large, and whose Brightness and Colour was pretty much as the upper part of the *Halo*.

As the *Halo* was at that time not quite perfect, but had some parts interrupted, I thought that the two *Parbelia* were in the Circumference of its Circle, as usual; but after about a quarter of an Hour, I directly observed the *Halo* to pass between the *Parhelion* A, and the true Sun; and I have no reason to doubt the same of the other, B, also, tho' I do not remember that I directly observed that.

The *Parbelia* A, B, therefore, which were but a little distant from the Circumference of the *Halo*, began now to appear with narrow, pale, whitish Streaks of Light, in the nature of Tails, proceeding from them; but soon extended themselves so far, that they met in the Point opposite to the Sun, and formed the Great Circle, ABCD, parallel to the Horizon, whose Breadth was about half that of the *Halo*.

Upon viewing it carefully all round, I soon discovered a third Mock-Sun, C, of a plain whitish Light, without any mixture of Colours, (which was also the Case of the great Circle,) and presently also a fourth, D, both of them pretty exactly resembling each other, (as the two first did themselves likewise,) very much inferior to the *Parbelia* A, B, in Brightness, tho' not so much in magnitude; for I estimate



estimate their Diameters to have been to the two first *Parbelia*, as 4 to 5.

As I had no opportunity of measuring the several Angles, I have placed the Mock-Suns, C, D, in the Scheme, rather in Agreement with former Observations, than my own Gueffes; for they appeared to me to be at a greater distance from each other, and nearer respectively to the two first *Parbelia*, which Difference M. *Huygens* attributes to the different Altitude of the Sun.

The Arch, NVT, not being very visible while the Great Circle was, and indeed not extending itself at any time near so far as to the *Parbelia*, or the Circumference of the great Circle, I could not determine by a direct Observation, whether the *Parbelia* A, B, appeared in the Intersection of that Circle produced, with the great Circle; but the Curvature appeared to me so plainly different from that, it's Center not being, I reckon, above M, that I cannot but believe the *Parbelia*, A, B, were neither in the Intersection of NVO, with the great Circle, ABCD, nor of the *Halo* with the same Circle, in one of which Circumstances they have hitherto appeared; but between those two Points, and much nearer to the Circumference of the *Halo*.

I thought I saw plainly at one time likewise, a small Portion of a Secondary *Halo*, if I may so call it, as in the Scheme at P. It seemed evidently to be an Arch of a Circle concentrical with the *Halo*, and tinged with the Rainbow-Colours, whose Diameters might perhaps be to that of the *Halo*, as 4 to 3; but as it appeared but for a little time, I would not be thought positive about it.

I don't at all remember, that during the time I watched it, I ever observed the great Circle ABCD, to be visible within the *Halo*, between A and B, tho' all the other part of it was sometimes very perfect.

This Face of the Heavens continued, tho' with an Interruption of some parts now and then, till about a quarter after eleven, when I left it, and could not return till about twelve, at which time the Sky was clouded over, (which had been before only hazy, a sure Criterion of these Appearances) and this *Phænomenon* no longer visible.

XXIII. On the 7th of *September* last, about Nine in the Morning, I was riding with some Friends over *Port-Mead* near *Oxford*. The Morning had been misty, and the Grass was very wet with the Dew. We had not been long out, before the Air cleared up, and the Sun began to shine very bright. We soon after had the Satisfaction of seeing a Rainbow upon the Ground, whose Colours were very near as lively as those of the common *Iris*: This was extended upon the Ground for some Hundreds of Yards, and the Colours were so strong, that it might have been seen much farther, had it not been terminated by the Bank, and Hedge of the Field. It is hardly worth while to observe, that it continually changed it's Place as we moved along, since this is no more than happens in other Rainbows. The more remarkable Particulars were these:

*A Rainbow  
seen on the  
Ground by the  
Rev. Benj.  
Langwith,  
D. D. No.  
369. pag.  
229.*



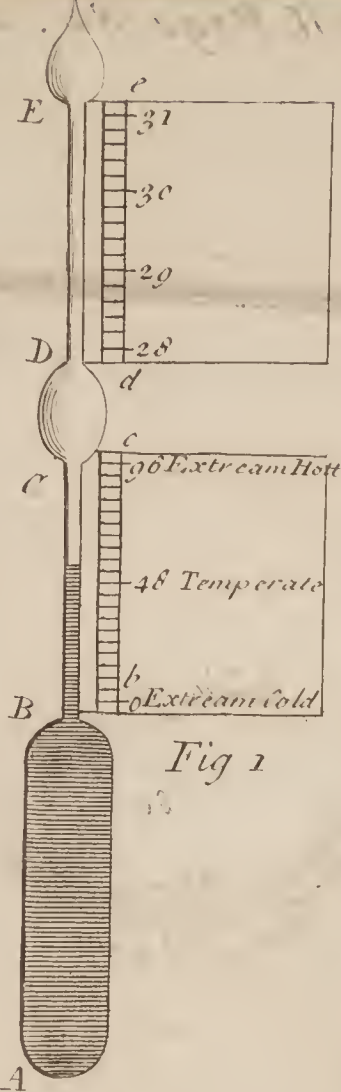


Fig. 1

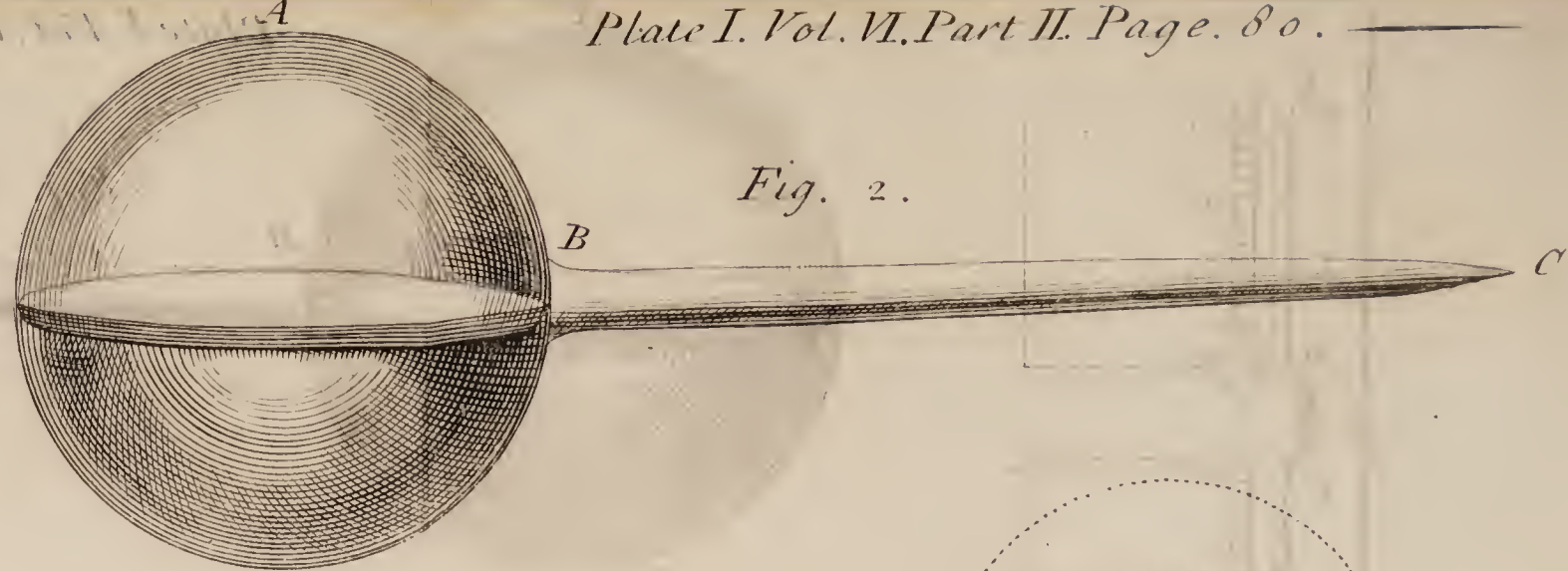


Fig. 2.

Fig. 4. Bulk = 1 = Bulk = 1 =  
A = 0 = W = 0 =  
Weight = 1 = Weight = 350 =  
Bulk = 8000 = Bulk = 8000 =



Weight = 8000 = Weight = 850 =

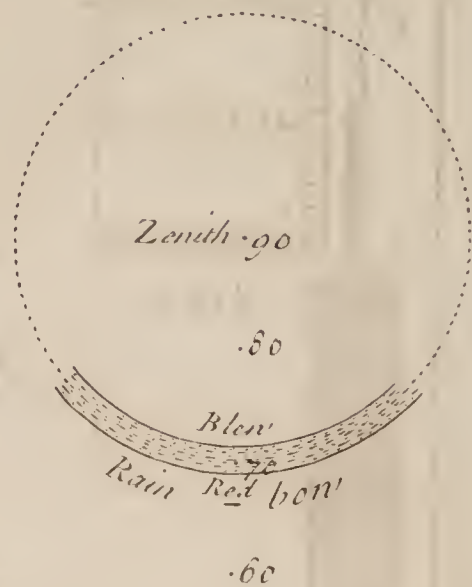


Fig. 6.

Fig. 3.

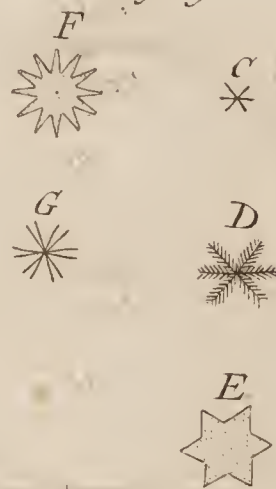


Fig. 5.

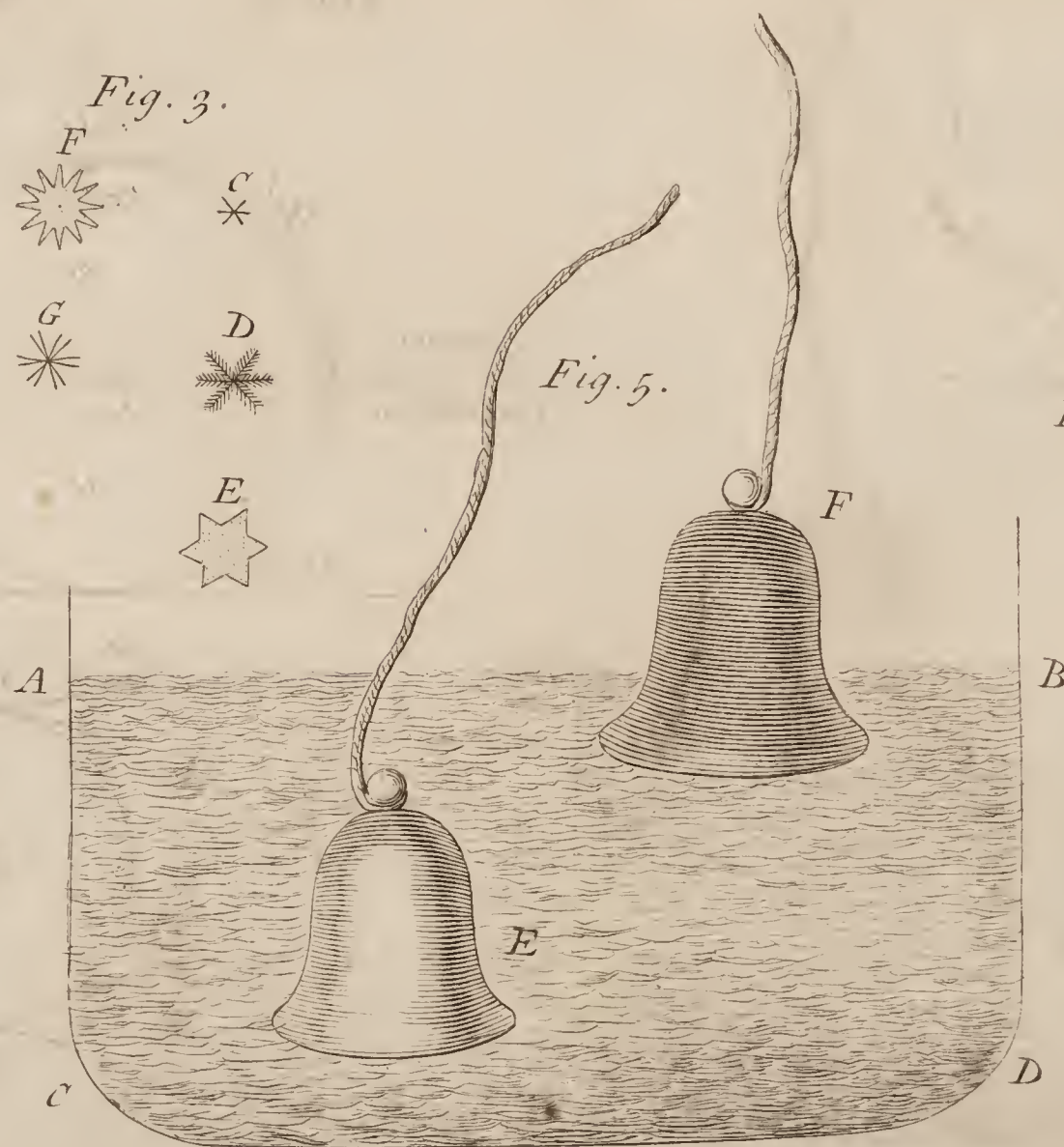


Fig. 8.

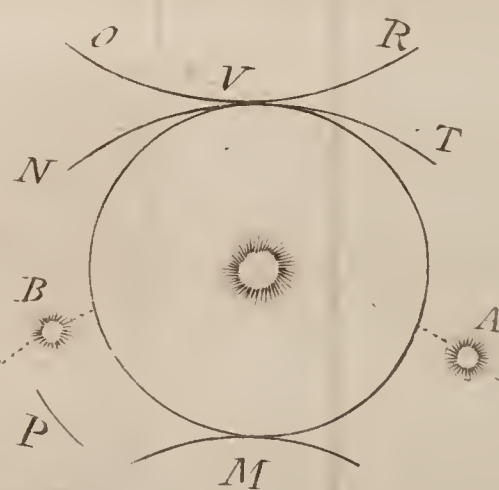
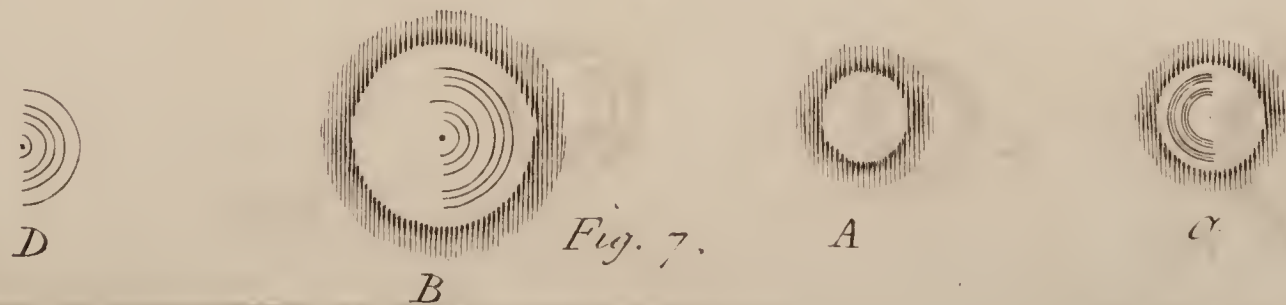


Fig. 7.









1. That the Figure of it was not round, but oblong; being as I conceive, a Portion of an *Hyperbola*.

2. That the Convex Part of it was turned towards the Eye, and the *Vertex* was at a small Distance before us.

3. That the Colours took up less Space, and were much more lively in those Parts of the *Iris* that were near us, than in those at a Distance.

These *Phænomena* may easily be accounted for, by comparing this Fig. 91 *Iris* DCE, with the common *Iris* *kiEe* formed by Drops falling in the Air at a small Distance from the Eye of the Spectator H, and touching the Ground with the lower Part of it's Arch in E, the vertical Point of the *Iris* DCE. Produce the Cone H*kiEe*: It's Intersection with the Plane of the Horizon will give the Figure of the *Iris* DCE. Hence it follows,

1. That as the Angle *eHG* happens to be greater, equal to, or less, than 90 deg. the Figure will be a *Hyperbola*, *Parabola*, or *Ellipsis*.

2. That as the Sun was about 30 deg. high, when we viewed the *Phænomena*, the *Iris* was a *Hyperbola*.

3. That the Arches of the same *Iris*, consisting of Colours of different Refrangibility, may also in some Cases be different Sections of the Cone.

4. That since the Angle *eHF* is always given; from the Height of the Point of View H*G*, and the Sun's Altitude S*LA*, the Dimensions of these *Iris*'s are easily determined.

XXIV. It began about 10 a Clock on *January* 12th 17 $\frac{1}{2}$ <sup>20</sup>, but had nothing very remarkable till about half an Hour after Eleven, when I was call'd out to see it, by the Servants, who had been looking at it about half a quarter of an Hour, and told me it looked just like Fire. But it appeared first to me in long Streams of Light, of a round Body, as at A, and very bright, tho' some were coloured, as at A*a*. They came before the Wind, which was then *West*, as near as I could guess, there not being a Cloud in the Sky, and the brightest Moon I have known. We had Rain about Five, but at 6 a Clock the Night was clear. The Streams of Light A*A*, moved very slow, (there being but little Wind) but as they moved they joined, and, swelling out in the middle, formed themselves into the Figure *bbB*, continuing to advance slowly in that shape for about a Minute, when the two Ends *bb*, approaching near each other, as described by the pricked Lines, the advanced part B, suddenly, and with great Swiftnefs, ran back, and joining it self with the Ends *bb*, formed it self into the Figure C, quivering in the upper part, and darting down perpendicularly in sharp Points, as at D*DD*; and it's Colour from a bright Light changed into the Colours of a Rainbow, but much fainter. It continued this way about a Minute,

VOL. VI. Part ii. L and

*A Luminous Appearance in the Air at Dublin, By Philip Percival, Esq; No. 364. pag. 215. Fig. 10.*



*A great Meteor at Cambridge.*

and then the sharp points D D D, gathering themselves up into C, it changed again into a square Sheet of Light, as at E, and swell'd out at F, as before at B; and advancing leisurely, repeated the same Scene as before, 'till it seemed at a great distance to disperse it self into small thin light Clouds; tho' 'tis probable that to those who saw it in a like Situation, as it travelled, it might make the same appearance as it did to me. I was very particular in observing it, and the next Morning drew it, and I think very exactly. I should have continued longer to look at it, (which I did for above a quarter of an Hour) but that it was excessive cold; the beginning of it was very like the *Aurora Borealis*, which has been very frequent this Winter here.

*A great Meteor at Cambridge, by Mr Roger Cotes, Plumian Professor, No. 365. p. 66.*

XXV. I am told that some Streams were seen to shoot forth immediately after Sun-set, and that they did not perfectly cease till about 3 or 4 in the Morning. It was after 7 before I had Notice of it. At first I saw only two or three of the Triangular Streams towards the North and North-West: These were not of long Duration, but were succeeded by others which appeared and vanished again by turns, arising from, and ascending up to Places in the Heavens, of very different Altitudes above the *Horizon*. From the Time I began to view them, they continued to ascend more and more copiously, being propagated still further and further from the North towards the West and East, and directed always to the Head of *Gemini*; till at length, when they seemed almost to meet at the Point of Convergence, they began to ascend up towards it from the Southern Parts also, and all around it; insomuch, that at a quarter after Seven, we had a perfect Canopy of Rays over us: The bottom of this Canopy did no where reach down to the *Horizon*; for near the North, where it descended the most, it's Altitude was about 10 or 15 Degrees; and near the South, where it descended the least, it's Altitude was about 40 Degrees. It remain'd in this State about 2 Minutes, during which time, we saw several Colours, some fainter, and some more permanent, others brighter, but quickly vanishing. Thus in the West I observed the Rays to be tinged for some considerable time with an obscure and heavy red; and in one of the brightest Streams at another time, there suddenly broke out a very vivid red, which was instantly and gradually succeeded by the other prismatic Colours, all vanishing in about a second of time. These Colours affected the Sense so strongly, that I thought them to be more intense than those of the brightest Rainbow I had ever seen. A small time before the Appearance lost it's Perfection, we were surprized to observe a shaking and trembling of the Streams, chiefly in their upper Parts, during which, their Convergence was confounded, and the whole Heaven seemed to be in a Convulsion. At the same time I could perceive Waves of Light towards the North, which moved upwards, and in their Motion crossed the Streams, ly-



ing parallel to the *Horizon*. These Waves were different from those broad ones, which you mention, and which I also took notice of; their breadth seemed to be about a Degree, their length about 90 Degrees; and I can compare them to nothing better than those slender Waves upon the surface of stagnant Water, which are made by casting in a small Stone.

About seven or eight Years ago, I happened to see a Meteor which *Fig. 101* it will be of use to describe to you. Along the *Horizon* in the North, there lay a white and luminous, and seemingly dense Matter in the form of a Cloud, represented by  $a b c d$ ; the length of it,  $a b$  was about 10 or 15 Degrees. From this there arose directly upwards, pointed Streams of the like luminous and white Matter, which yet did not appear in any part of it to be so dense as the former; and grew gradually more and more rare in it's upper Parts, so as to vanish almost insensibly at the Points. There was some little Difference in the Height of these Streams; but they generally ascended up to about 4 Degrees above the *Horizon*. They were very numerous and contiguous to each other, and seemed to be composed of very slender parallel Filaments or Rays. This was the common Appearance, and the only remarkable Thing that I farther observed was, that sometimes a Fire or Flame would break out in the Cloud,  $a b c d$ , and move along it in a direction parallel to the *Horizon*: And during this Motion, a pointed Stream directly over the Fire seemed to run along with it, and to pass by the other more fixed Streams, to which it always kept itself parallel.

I am persuaded that the late Appearance was of the same kind with this, which I have now been describing. For let  $A B$ , represent the Plane of the *Horizon*,  $C$  the place of the Spectator,  $E F$  a fund of Vapours, or Exhalations at a considerable Height above us, diffus'd every way into a large and spacious Plane, parallel to the *Horizon*. This fund of mixt Matter by Fermentation will emit Streams from it self, such as  $E G$ ,  $F H$ , &c. which, if the Wind be perfectly still, will ascend perpendicularly; if it be boisterous and irregular, they will be blended and confounded together; but if it be very gentle and uniform, as it was at the Time of our Appearance, they will be inclined towards the Point of the *Horizon*, which is opposite to that from which the Wind blows. Now if  $A D B$  represent the Concave of the Heavens, and a Line  $C D$ , be drawn parallel to the Columns  $E G$ ,  $F H$ , &c. 'tis certain by the Rules of Perspective, that these Columns will appear upon that Concave to converge all around towards the Point  $D$ : Thus the Column,  $E G$ , will seem to arise from the Point  $e$ , to ascend up to  $g$ , and to take up the space  $e g$ ; and in like manner the Arch  $f b$  will be the Projection of the Column  $F H$ . From hence it is evident, that the Reason why the Triangular Streams ascended at first only from the Northern Parts of the Heavens was this: The Fund of Matter;  $E F$ , was not yet arrived



arrived by it's Motion to the Line C D, after it had passed that Line, it is plain they must appear to ascend from all Quarters. A great number of Columns being therefore disposed to emit Light at the same time, caused that perfect Conopy, which I descibed above. The reason why that Canopy descended lower in the North than in the South, was this : The shining Columns, which had not yet passed the Line C D, were more numerous and more remote from it than those which had passed it ; for if the Point E, be farther distant from C D than the Point F, the Arch A e, must needs be less than the Arch B f. An irregular Gust of Wind blowing upon and shaking the Columns, was (I suppose) the Cause of that trembling, which appeared in the Triangular Streams, and the Cause also which destroyed that fine Appearance of the Canopy. The slender circular Waves seen at the same time might also be explained from the same Cause. I need not detain you any longer by endeavouring to make out some other particulars of this unusual Appearance : I fear I have been already too tedious. However I will not omit to mention a very easy Contrivance by which the Thing may be tolerably well represented to view. Take a Hoop and round about it fasten several streight Sticks parallel to each other, but all inclined to the Plane of the Hoop, hold this Plane parallel to the *Horizon*, and in that Posture move it with Sticks over a Candle, the shadows of the Sticks upon the Ceiling of your Room, will converge to a Point not directly over the Candle, (as they would have done, had the Sticks been perpendicular to the Plane of the Hoop) but to the Point in which a Line drawn from the Candle parallel to the Sticks, shall intersect the Plane of the Ceiling.

*An Aurora Borealis*, Sept. 20, 1717, near Upsal, by E. J. Burman; *Act. Lit. Suet. An.* 1724. *Trimest.* 3. N<sup>o</sup>. 385. p. 175.

Chasmata, uti vocantur, cœli, quæ alias horizontale lumen & aurora septentrionalis audiunt, Suethice *Nord-skjen*, *Nord-ljus*, *Nordblyfs*, *Nordblåfs*, *Låterskjen*, *Lyssnor*, &c. illæ, vulgi, judicio, acies, seu exercituum præliorumque ideæ, Meteoron in regionibus nostris, aliisque Polo vicinioribus, illustre sane & frequens (frequentius hodie quam olim nobis ætate provectiores persuadere volunt) justa cum diligentia sæpius observavimus. Communicabimus unicum, quod A. 1717. d. 20. Septembris in nocturno itinere accuratius considerare licuit, & cujus rarior planeque singularis facies conjecturam de natura phænomeni parastatica eruditorum examini accuratiori heic subjiciendi ansam dedit.

Erant solito plures phasmatum horunce tractus, arcus nimirum albicantes & reliquo cœlo (sereno utique ac tranquillo) lucidiores, quatuor ad minimum aut tres, mediocribus tenebrarum intervallis distincti, & unus supra alterum positi. Quod autem rarissimum ad spectuque jucundum, dictorum arcuum distantia sub ipsa Cynosura maximæ (infra quam supremus quidem ultra viginti & sex gradus non consistebat, quippe per quem stella Ursæ majoris Dubbe leviter subinde transparebat) versus horizontem utrinque sensim decrescebant, donec



donec illi tandem in ipsis orientis occidentisque cardinibus mutuo sese interfecarent, haud secus quam in artificiali globo Meridiani ad Polos Æquatoris convergere cernuntur. Candidi isti arcus seu semicirculi maximam partem ex striis distinctis & ad horizontem normalibus constabant, præsertim in summitate, vel sub ipso septentrione; ad latera lux debilior conspiciebatur ac subobscura.

Striarum geminus erat motus, horizontalis unus, alter perpendicularis: hic minor longe & tardior, ut vix circulare arcuum formam turbaret; ille varius simul atque celerrimus, ab oriente in occidentem, & retro. Quoties autem striæ plures (quod sæpius accidebat) a contrariis venientes plagis sibi invicem occurrebant, sive id in medio arcu, sive alibi fieret; toties, quasi ex illa radiorum mixtura seu multiplici intersectione proveniens colorum pulcherrima apparebat varietas, & quidem ordine prorsus eodem atque in prismate vitreo, explicatis solique obversis avium minorum pennis, aliisque corporibus similibus colores produci solent.

Hinc vero dari occasio poterit adhuc de Opticis phænomeni rationibus, cum *Cartesio in de Meteoris Cap. VII. §. 18.* cogitandi; sed neque tamen ideo subtiliori materiæ sulphuræ in regione aëris inferiori accensæ omnem denegari posse locum existimamus. Ipsi enim alias sæpius, præsertim in chasmate A. 1716. d. 17. Martii heic longe illustriori quam in Anglia, Gallia, Germania, alibi, per totam noctem viso, colores multo plures, necnon susurros & sibilos, quales excitari a focali flamma solent, observavimus. Forsan autem duo diversa statuere luminis borealis genera oportet: unum meteoron igneum ab effluviis & exhalationibus; alterum mere parastaticum, ex diversimoda solarium radiorum refractione & reflexione, sive in glacialibus quibusdam lamellis, stellulisve atmosphæræ regionem excelsiorem occupantibus facta, sive etiam in maribus quibusdam ad septentrionem, indeque nobis ex nubibus communicata, ortum. Certe posterius singulari experimento illustrari posse videtur, quod occasione jam descripti phasmatis (cui tamen simile vidimus A. 1716. in Februario hora vespertina 9. ex duobus ejusmodi arcubus semicircularibus, sed minus striatis & supra borealem horizontis plagam elevatioribus, constans) inventum factumque, huc redit.

Si lamina fumatur stannea longitudinis latitudinisque arbitrariæ, eademque acuto & fortiori cultro, uno ductu secundum longitudinem universam, donec tota striata facta fuerit, rafa, manu ita teneatur, ut ejus planum cum lucente candela & obscuro pariete tabulæ æquales faciat angulos; deinde autem variis modis incurvetur & torqueatur, ipsam nunc concavam nunc convexam parieti vel tabulæ obvertendo, tardius ad lubitum aut celerius: phasmata supra recensitis admodum similia spectaculo non injucundo repræsentabuntur.

Quid si utriusque generis lumen forte aliquando una existere, atque unum cum altero coincidere dicamus, ut neutrum alterius causa sit aut effectus, sed ambo ad noctem illuminandam terroremque spectatoribus



ſpectatoribus incutien dumconcurrant? Quemadmodum enim ſæpiſſime quidem lumen horizontale, Zonas videlicet candentes, nunc nudas (imo per ipſum fere Zenith tranſeuntes, quas cum Galaxia utut non parum latiori, ob ſimilitudinem vulgus confundere ſolet) nunc columnis, pyramidibus inverſis aliisque figuris variis ſtipatas, ſed citra omne aëris, ut ita dicam, incendium; ita nec raro hoc ſine illis vel antecedentibus vel concomitantibus, apparentiis diſtincte notatis, vidimus: quamvis etiam e regione quadam cœli, nude primum candente, tandem ferventiſſimas faces, ſive per ſolis radios in glacialibus Oceani partibus, ceu in ſpeculis quibuſdam cauſticis, reflexos, ſive alio quocunque modo accenſas, ad Zenith & ſuper totum nonnunquam hemiſphærium evolafſe fatendum ſit.

Sed quia genuinas veraſque phænomeni hujus admirandi cauſſas vix cuiquam certo invenire prius licet, quam plurimarum in diverſis terræ locis unâ habitarum obſervationum rite inſtitui queat comparatio; unde ante omnia conſtet, num lumen iſtud in remotioribus etiam locis ſub eodem altitudinis angulo conſpiciatur; num quod heic horizonti parallelum, alibi verticale ſit, & id genus alia; verbo, utrum unus idemque ſit arcus qui in diverſis locis conſpicitur, an quemadmodum in Iride, ita quoque heic, quot in terra ſpectatores, tot arcus in cœlo: Enixe proinde omnes in univerſum atque ſingulos rogamus, quibus rerum naturalium in aliquo pretio eſt ſcientia, velint ubicunque terrarum, maxime vero in regionibus borealioribus, boreali huic lumini quoad omnes circumſtantias obſervando quam diligentiffime invigilare, ſuaque obſervata quantocyus cum publico vel ſaltem nobiſcum communicare, gratiam ab erudito orbe ſane maximam merituri. Nos alia occaſione quaſdam regulas ſeu harum obſervationum normam & exemplar dabimus, parati interim & ipſi aliorum monita grato excipere animo, & quænam judicaverit quiſque potiora hujus negotii momenta, fieri certiores.

—at Dublin,  
Feb. 6, 17<sup>20</sup>.  
By J. W. No.  
368. pag.  
180.

XXVII. 1. The Air was all that Day, as it had been for ſome time before, vey clear and ſharp; abouthalf an Hour paſt four in the Evening, ſomer flying Clouds appeared, and the Sky was tinged with a very unuſual yellowiſh Colour, which perhaps might be reflected from a great Quantity of Snow, that ſoon after fell for near a quarter of an Hour. However that might be, I'm willing to date the beginning of the enſuing *Phænomena* from the firſt appearance of this uncommon Light. About a quarter paſt ſix, a thin Vapour, which was as yet very ill defined, and in all appearance reſembled an exceeding black Cloud, had fixed itſelf in the Northern *Hemiſphere*; it's Edges were tinged with a rediſh Yellow, that by degrees, as it approached the *Vertex*, grew more dilute, till at laſt it ended in a faint Whitenefs. That in reality it was no Cloud, but only a Vapour exceeding pure and limpid, was manifeſt, becauſe ſeveral of the fixed Stars ſhone thro' it, without having their Light in any degree effaced. In the miſt of this dark *Baſis*, about half an Hour paſt ſix, a lucid *Area* ſhewed



shewed itself due N. E. about 35 deg. above the Horizon, and in less than a Minute from the time I first discovered it, emitted a very large *Pyramidal* Stream of shining Vapour, which with an incredible Swiftnefs ascended obliquely towards S. S. W. so as to leave the *Zenith* considerably to the Westward, and very soon after, about the same Place, six others arose at the same instant almost to the *Zenith*. From this time till 48 Minutes past six, we had repeated Projections of these lucid Rays, without any order as to Time, Place, or Magnitude. They did not only arise from behind the dark *Basis*, but sometimes as it were out of the pure Sky; and tho' some of them continued visible more than a Minute, yet the greater part of them only just shewed themselves and died away. I had now got to the Top of a convenient Observatory, where (though destitute of Instruments) I had a free Prospect of the *Horizon*; and in company of another Gentleman, fixed myself with great Attention, to expect the ensuing *Phases* of this *Phænomenon*.

About 6 h. 55 m. between N. W. by N. and W. N. W. we found the Representation of a very bright *Crepusculum*, such as that which appears about 20 Minutes after Sun-set; from which arose several very large Beams of Light, not exactly erect towards the *Vertex*, but somewhat declining to the South; among these, one which arose about N. W. and in three or four second Minutes passed over 50 or 60 degrees of a great Circle, was above all others that had preceded, the most splendid: It's sides were inclined to each other with an Angle of about 8 or 10 Degrees, and were tinged with a brisk lively Red, which by degrees, as it approached the *Axis*, became more intense and dirty: On the other hand, receding from the *Axis*, it's Colour was a pale Yellow, that soon lost itself in a faint Whiteness.

From this time no Moment passed without such Variety of different *Phases*, that it was impossible for the Eye of any single Person to pursue it thro' the suddenness of it's Alteration. While some of the lucid Beams seemed to stand fixed, as it were, among the Stars, others moved slowly from *East* to *West*, by which they seemed to meet each other, sometimes to recede from each other, and sometimes by a kind of apposition, great ones were produced from others of an inferior order.

The lucid *Area*, which I first discovered in the N. E. had now formed itself into a *Parallelogram*, whose upper and lower Edges were 5 or 6 Degrees distant from each other, and nearly parallel to the *Horizon*: In this, as if behind a Curtain, vast Waves of Light, whose Extremities did not reach the *Periphery* of the dark *Basis*, seemed to meet and pervade each other; at other times, while some of them, with a remarkable Velocity, moved Eastward; others, as if behind them, would fly towards the *West*; by which variety of different Motions, as often as any Interval passed between the Collision of these  
erect-



erect Waves, a beautiful Undulation was produced, and it's Pulses, by the adjoining Parts of the Fluid, were propagated to a vast distance.

While we stood amazed at this surprizing Sight, the *Axis* of the coloured *Pyramid*, which arose in the N. W. had moved considerably toward the *West*, and at 7 h. 25 m. was about 23 or 25 Degrees to the *North* of *Venus*. The dark *Basis* of this Meteor had now extended almost to the *East* Point of the *Horizon*, and at half an Hour past seven, between E. N. E. and E. by N. several large Columns ascended in an instant to the *Zenith*; the most Eastward whereof was remarkably convex toward the *South*, and tinged with a pale Red, as were most of those which ascended with it. They were met by others, that arose at the same time between the *North* and *West*, and in the *Zenith* formed a vast Collection of Vapour, that pretty much resembled Smoke inlightned by the Sun's Beams; it's Waves reflected a brisk, lively red Colour, and in some places a pale Yellow; they rolled indifferently any way; and in little more than a Minute, when the first Efforts of their Congress were spent, and all seemed fixed and serene, the *Corona* projected several small Rays, which with a slow uniform Velocity descended between W. by N. and N. W. soon after which it died away.

We had not much time to lament the Absence of our *Spectrum*, for at 7 h. 40 m. several other *Striæ* were discharged from behind the dark *Basis*, which intersecting with others, that at the same time arose about the *East* and *West* Points, formed in the *Zenith*, or rather 6 or 8 Degrees to the *South* thereof, a second much more elegant and surprizing than the former, and indeed than any thing that had yet appeared: it was not only tinged with different Orders of red and yellow, but also with blue and violet, the last of which, by a Mixture with the white Light, appeared faint and inclined to Purple. Tho' the Vapour, of which this and the preceding *Corona* were formed, was so exceeding thin and pure, that several of the fixed Stars were visible thro' it, yet it reflected a Light so copious, that I could thereby perfectly distinguish the time of night by a small Watch. While thus delighted, our *Phænomenon* ejected four or five large Columns toward the N. W. (besides others toward the *South*) which appeared pointed at the Top, and their Sides inclined to each other with an Angle of 5 or 6 Degrees. When their Bases were extended about 30 or 35 Degrees from the *Vertex*, the lower Parts of two or three of them broke, as it were, by the meer Weight of the Vapour, separated from the upper, and descended with a slow Motion, in the Form of truncate Cones: they were gradually followed by their upper Parts, and in about a Minute were lost in a large Body of Light that was settled between the N. W. by N. and W. N. W. The *Corona*, as if exhausted by these great Discharges, became immediately more dilute and languid, it's lively Colours faded, and were succeeded by a whitish



whitish vibrating Light, that in less than two Minutes intirely disappeared.

The dark Vapour, which continued to possess the Polar Regions, had now extended itself from the *East* to the N. W. by N. point of the *Horizon*, and was formed in a large Segment of a Circle, whose Center was about 20 Degrees below the *Horizon*: it's upper Edge was tinged with a pale Red, which was soon lost in a florid Yellow, and this again, as it approached the *Zenith*, became more effœte and languid. In this dark Segment several lucid *Areas* frequently discovered themselves, with a vibrating Light, which instantly disappeared, as if a Curtain were drawn over them; and from it's Rays of very different Magnitudes continued to ascend without any Uniformity as to time and place, till 48 or 49 minutes past seven, when a third *Corona*, very little, if at all, inferior to the preceding ones, either in the Variety of it's Colours, or in the quantity of Light it emitted, was formed in the *Zenith*. As the preceding were both produced by the Northern *Striæ*, so this was augmented by two or three large ones, that arose due *South*, out of the pure Sky, and were, in all probability, part of the Vapour, which had been projected beyond the *Zenith*, or which had subsided from the two former: they caused the Vapour, of which this Image was composed, to move with great Violence, in different Directions, not unlike Waves of Smoke, confin'd in a reverberating Furnace; this Motion being abated, the Vapour acquired a kind of Stagnation, in which State it continued but a very short time, before it projected several lucid Beams, an inevitable Fore-runner of it's approaching Dissolution, between the *North* and *West*, and soon after, pardon the levity of the Expression, *Noëti se immiscuit atræ*.

About this time, the great Beam, which arose in the N. W. and had preserved it's Colours in their original Beauty, for more than three quarters of an hour, began to fade, and at 7h. 53m. was absorbed in a vast body of Light, which seemed fixed in that part of the *Horizon*: it had moved in that time 15 or 20 degrees to the *Westward* of the Place from whence it arose. The *Impetus* of the Vapour being now pretty much abated, we had nothing extraordinary but successive Discharges of pointed Rays between the N. West, and E. N. East; without any order or Uniformity as to time or place; setting aside these, there was very little difference in the general face of affairs for 20 minutes; neither had we much reason to hope for any, because the severity of the Cold was such, that it obliged us to remove to a better Climate, and by that means we unfortunately lost the ensuing *Phases* of our dying *Meteor*.

2. Monday the 6th of Feb. 17<sup>20</sup>/<sub>21</sub>, a little before 7 in the Evening, there arose out of the *North*, or a little towards the *East*, a bright *Crepusculum*, which soon spread itself a great way through the Northern part of the Hemisphere. About 7 (when I first saw it) it began to leave

—at Cru-  
wys-More-  
hard, in De-  
vonshire. By  
Samuel Cru-  
wys, Esq;  
F. R. S. No.  
368. pag.  
186.



behind it, at due *North*, or a few Degrees to the *East*, part of a very clear Sky (which looked like a black Cloud, but the Star shone in it clearly) being a Segment of a Circle, into which Figure, the *Crepusculum* (or expanded Body of lucid Vapour) had now formed it's upper Limb also, making a kind of broad *Iris*, terminated at each end by the Horizon.

All this while the streaming Lights appeared in great Variety as to Figure, Place, Magnitude, and Colour, but for the most part of a redder Colour (especially towards the *West*) than the *Crepusculum* itself, out of which they seemed to be formed, and tho' for the most part the greatest Appearances had been within 20 Degrees of the *North* on each side, yet at due N. W. there were very many considerable ones.

About 8, this *Crepusculum*, (which had been constantly, though slowly, carried further from the *North*) had, with the upper part of it's outer Limb, reached to about 10 or 12 Degrees beyond the Pole-Star towards the Zenith, being now above 30 deg. broad, with a circular Segment of black clear Sky to the *North*, of about 25 deg. when the whole *Crepusculum*, or Vapour, was all suddenly formed into aggregate Bodies like Vapours, and gave one of the most pleasing Appearances, that perhaps has been seen of this kind. The *Bases* of the Cones seemed to rest on the upper Limb of the Segment of clear Sky (which was extended near 60 deg. on each side the N.) and the Vertices of the Cones, pointing all towards the Zenith, approached within a few Degrees of it, and terminating there, formed the greatest part of a Semicircle inclosed, as it were, with Golden Pallisadoes, which shining all at once as bright almost as Flame, and being of a prodigious Length and Number, exhibited a most agreeable Spectacle.

This last *Phænomenon* convinced us, that these Cones were Collections of the very same Particles, whereof the *Crepusculum* had consisted: because when it appeared every where alike and equal, the great Stars shined through it but very faintly; whereas afterwards, those Stars, that remained between the Cones, suddenly appeared very bright, whilst those, that were covered by them, could hardly be perceived: and indeed all the streaming Lights this Evening seemed to flow from this *Crepusculum* downwards, as from a Fountain or Store, and not to arise from the Horizon, few approaching it nearer than 10 Degrees, and many not within 20 or 30 deg.

After this fine Appearance had continued about 2 Minutes, the Matter seemed to be exhausted, and the Scene almost at an end, the streaming shining Lights being mostly extinguished, and the remaining Parts of Vapour left, like broken Clouds; when the flashing Lights began to appear of a most prodigious Swiftnefs, both from N. E. and N. W. pointing to the Zenith, or a little more to the *South*. 'Twas observable, that over the Tracts, where these flashing Lights passed, the remaining parts of Vapour (which now lay scattered



ed every where, like white broken Clouds) pointed, or seemed to have a Tendency, conformable to the same Motion; whereas, towards the due *North*, where no Flashes appeared, these whitish Clouds lay confused and irregular as before.

This continued about 20 or 25 Minutes, when the Wind began to arise a little at N. E. and the Scene was quite at an end, dark Clouds succeeding all over the *North*, and by nine a Clock we had a severe Storm of Snow.

N. B. *That all the time of these Appearances, many broken parts of the extinguished Vapours, like white Clouds, were carried beyond the Zenith, some 50 or 60 deg. and others, even to the Horizon itself, at S. S. W.*

During the whole Continuance, there seemed to be a small, easy breath of Wind, scarce perceivable, at N. N. E. which the Motion of the Clouds abovementioned also confirms, but as soon as it began to blow a little brisker, the remaining parts of the Vapour were all dissipated.

*An Account of the Weather both before and after this Phænomenon.*

- January* 30. Hard Snow in the Morning, and Frost all Night.  
 31. and *Feb.* 1, 2, 3, 4. Pleasant Sun-shine Days, very calm, but the Snow still lying, and at Nights very hard Frosts.
- February* 5. Very violent Snow in the Morning, and some Thaw in the Afternoon, hard Frost at Night.  
 6. Hard Frost in the Morning, and the Wind exceeding cold and sharp, but not hard; the afternoon pleasant, Sun-shine and calm, but it froze all Day out of the Sun, and continued to do so all the Evening, and the Ground was still covered with Snow.  
 7. Very hard Frost in the Morning, and Frost and Storms of Snow all Day. Wind N. N. W.  
 8, 9, 10, 11. Pleasant calm Days, but hard Frost, and very hard Frost at Night.  
 12. Hard Frost. Exceeding cold Wind at S. E.  
 The 12th at Night these Lights are said to have appeared again, as also on *Saturday* the 18th, to a very great degree, but I saw them not; the Weather still frosty with little Snow.  
 22. At Night, hard Snow.  
 23, 27. A Thaw and some Rain, and but little Frost afterwards, only dry cold Winds, till the 27th, when the Frost returned very sharp, with exceeding cold Winds, at N. E. and S. E. for a Fortnight or more, without any Snow, and did a great deal of hurt.



Observations  
on the Aurora  
Borealis for  
four Years, at  
Lyn, in a Letter  
to Martin  
Folkes Esq;  
Soc. Reg. V.  
Præf. No.  
376. pag.  
300.

Fig. 12.

XXVIII. Mirum illud Phænomenon sexto Martii 1718. non licuit mihi inscienti videre, quod infortunium haud exiguum in me peperit studium subsequenter Phænomenis invigilandi. Priorem observationem, quam hic subjeci, summâ curâ delineavi, statim atque vidi, ideoque, ni fallor, a vero parum discrepat. Reliquas etiam descriptiones pro certo habeas accuratas esse. Quænam sit causa harum coruscationum, nondum, ut opinor, satis exploratum est.

Die Veneris Sept. 5. 1718. circa hor. x. Phænomenon hoc, in tabula delinatum observatum fuit Lennæ Regis, in puncto boreali.

Die Saturni Sept. 6. circa horas viii & x. perplures Luminis columnæ, similes supradescriptis (aa) observabantur, non æque lucidæ ac pyramides nocte præcedente observatæ, quæ ferebantur versus orientem, hæ vero ad occidentem.

Die Jovis Sept. 11. perplures istiusmodi columnæ iterum conspiciuntur cum motu occidentali.

Die Saturni Sept. 13. circa horam xi. Aurora Borealis lucidior ac altior fuit, longioribusque pyramidibus adornata, quam adhuc observata fuerat. Adeo lucebat hâc nocte, ut characteres in libro legerentur.

Die Saturni vero Octob. 11. circa horas x. & xi. Aurora Borealis lucidior quam unquam fuit, ac coruscationibus pyramidalibus interspersis, haud multum absimilis Phænomeno prius observato, Sept. 5. Lumine iterum ita splendente, ut legere liceret.

Die Veneris Dec. 19. circa horas viii & ix. Hâc nocte visi sunt cum Aurorâ Boreali perplures lucis radii, e nube veluti nigrâ exorientes; revera autem non fuisse nubem exinde patet, quia stellæ per illam clare videbantur. Quid vero aliud fuerit, haud facile est dictu. Sed quod præcipue notavimus, fuit motus horum luminum sane mirabilis. Hos radios observavimus in statu semper mobili, positiones suas, seu loca, perpetuo mutantés; cursum suum modo hâc, modo illâc, rursus, prorsus dirigebant, & interdum alii ex aliis eâdem viâ singulatim progressi sunt, & aliquandiu sibi invicem collisione mutuâ impingebant cum tremulo ac vibrante motu, & celeritate fere incredibili. Radii quidam observati sunt usque ad Zenith se porrigentes. Visa est sæpe lux se in acervum collegisse, atque ita mirum exhibuisse fulgorem coloribus Iridis tinctum, & iterum visa est se dilatasse. Luna hâc nocte lucide splendebat.

Die Jovis Martii 12. 1718. circa horas x & xi. Aurora Borealis rursus observabatur.

Fig. 13.

Die Veneris Martii 27. iterum visa est Aurora Borealis cum radiationibus variis obliquis, secundum hanc Figuram.

Die Lunæ Octob. 26. 1719. hâc nocte etiam visa est circa horas vii & viii.

Item die Lunæ Nov. 9. 1719.

Die Domin. Jan. ult. 1718. Hâc nocte, ab horâ septimâ usque ad decimam, Aurora Borealis visa est altior, quam unquam antehac observata



fervata fuit, per dimidium cœli ab oriente usque ad occidentem, fere obducta coruscationibus variis interspersis, adeoque lucebat, ut characteres in libro perquam distincte videri possent.

Die Saturni *Sept.* 17. 1720.

Die Lunæ *Jan.* 6. 1721. circa horas VII & VIII. visa est iterum Aurora Borealis cum coruscationibus pyramidalibus, undique a Zenith, veluti centro, obductis, imaginem exhibentibus pæne instar Umbellæ.

Die Domin. *Jan.* 12. 1721.

Die Lunæ *Sept.* 11. 1721. circa hor. IX.

Die Mercurii *Sept.* 5. 1722. ab horâ decimâ ad sesquidecimam.

Die Mercurii *Octob.* 3. circa hor. IX.

Die Jovis *Octob.* 4. circa hor. X.

Die Domin. *Dec.* 23. 1722. circa hor. VIII.

XXIX. I observed, that the Theatre of Light forming an irregular variable Curve, was, as at most times formerly, from E. N. E. to W. N. W. the Horizon and whole Hemisphere serene, little or no Wind, what there was, seemed Northerly. The seeming Dawn, or Stage of Light generally continued in an irregular Curve; the one Point in the two first Nights whilst I observed it, began near the Horizon, near N. N. E. the other Point was at W. N. W. the Height of the Arch not exceeding 20 Degrees, in which there seemed to be a continual Dawn: Under that Field of Light seemed to be a dark Cloud, which, however, was a clear Sky, not filled with that luminous Vapour; because all the Stars appeared distinctly and twinkling thro' it. Whenever that Light rose about 10 Degrees higher, to about 30 Degrees, then Flashes, or Coruscations followed alternately, and seemed to be Pillars or Beams of Light, which followed or succeeded one another, and by that means seemed to move and change with one another, by the Succession of Light and Darkness, according to the Flashes. When the lighted Vapour rose higher to about 40 or 45 Degrees, then the Appearance altered; and instead of Beams, or Pillars of Light, as when lower, there were Flashes like those attending Explosions, wherein faint Colours of Red, Green and Yellow appeared, but not very vivid; and upon each Explosion it would spread upwards towards the Zenith, in the Appearance of thin enlightned Clouds, and immediately disappear. On the 26th, about 9 at Night, one of these irregular Arches of Light had got up to the Zenith, the lower Points being near E. N. E. and W. S. W. I then saw it for a considerable time, at least a quarter of an hour, and it had been there for some time before I saw it. I could distinctly observe all the different Appearances, according to it's Altitude in the Hemisphere, viz. the lower part (being within 12 or 14 Degrees, as near as I could compute) was a constant fixed Light, equal to the Light of the Edge of a white Cloud in the Day-time, when the Sun shines on it. As it rose higher, I could observe it somewhat weaker, and could perceive the Motion of the Pillars or Beams of Light after each Flash,

—Sept. 24,  
25, 26. in Ire-  
land; 1725.  
by Arthur  
Dobbs, Esq;  
No. 395.  
pag. 128.

which



which seemed by that means to move. Somewhat higher again, at about 40 Degrees, the Flashes were like Explosions of great Guns, with the faint Colours observed as before; but the Coruscations or Flashes from thence to the Zenith, expanded at every Flash, like a broad, thin, white Cloud, of which some faint View could be seen after each Explosion for some time: And after all the Explosions were over, there remained a thin dusky Vapour in and near the Zenith, and all along the Arch from *East* to *West*, from 14 to 20 Degrees broad, which undulated and moved like a stormy Sea, the Motion coming from the S. S. E. and so lessened till it appeared no brighter than the Milky Way, but more like a very thin Cloud or Mist, thro' which I could perceive the Stars. At the same time I saw another thin Cloud, having the same Appearance, Arch-ways; to the Southward, at about the Height of 40 Degrees, which I suppose had been another, which had been over, and had moved thither from the Northward before I went out: And during the whole time there were lesser Lights towards the *North*, but dispersed here and there, and not forming any large Body of Light. During the whole time, the Hemisphere was clear, except a few very small Clouds near the Horizon; and when any moved into the enlightened Arch, they broke the Connexion, so that the Light was above them: At the same time it froze hard each Night.

*Solution of  
this Phæno-  
menon.*

From these Observations, I suppose that the *Aurora Borealis* is a thin Nitro-sulphureous Vapour raised in our Atmosphere considerably higher than the Clouds, which is discontinued in several Places by the interspersed Air, and which by Pressure and Motion is kindled; and perhaps the Explosion of one may by it's Shock and Motion contribute to kindle the next; by which means they go off one after another, till the whole Vapour within their influence is discharged, and then the Light disappears, and the thin Smoak appears, and undulates, according to the Motion in that part of the Atmosphere. And hence I think, most of the Appearances may be solved: For 1<sup>st</sup>, As to the continued Light near the Horizon, they being at a great distance from us, and nearly in a Line, all these Explosions may seem as a continued Light: When these approach nearer to us, and by consequence appear higher in our Hemisphere, we observe the Motion in each Flash, and still seeing them laterally, yet somewhat breaking the Continuity of the Light; they (by the Reflexion of the Vapour floating in the Atmosphere, and being not reflected, where the Air betwixt them is free of those Vapours) may appear as Pillars: And as the Flash below and beyond them moves (as it kindles and expands) so they seem to move, and perhaps are shocked at the same time by the Motion; but afterwards, when they are nearer, and raised to the Altitude of 40 Degrees, we get somewhat under them, and see the Expansion of the Explosion, which appearing somewhat globular, gives the faint Colours observed above, the Light not being intense enough



enough to make them vivid; and afterwards when they rise to, or near, the Zenith, they are nigheft to us, and then expand very wide at each Flash, like little Clouds: And, I think, the great Objection of their appearing in the Northern Part of the Hemisphere, and seldom or never in the Southern is in some measure answered by the Appearance on the 26th; since at least half of the Arch was in the Southern Part of the Hemisphere; and perhaps the Reason why the Light is not seen near the Horizon, in the Southern Part of the Hemisphere, may be this, that in clear serene Weather, the Wind being generally near the *North*, Objects from thence are much more distinctly viewed, and at a greater distance than from the South; and 'tis generally known, that Lands at a great distance are most distinctly seen, when the Winds blow from them.

And perhaps a cold Northerly freezing Air may be needful to kindle the Vapours, when a contrary Motion above (higher in the Atmosphere) may carry the sulphureous Vapour, which falling down from the Nitrous Vapour may be kindled. Which, I suppose, form the Undulations of the Smoak after the Explosion, which seemed, as above, like a stormy Sea moving from the S. S. E. *Note*, The Barometer was low for some Days before and after it.

XXX. 1. The Lights began about Sun-set; but I heard nothing of them till between 7 and 8. When I went out, I observed a Stream of Light almost due *West*, which was about seven or eight Degrees broad, and extended itself upwards about 35 or 40 Degrees. I had not a free Prospect of the Western Horizon, and so cannot tell what it's Appearance was below. It was not perpendicular to the Horizon, but inclined a few Degrees towards the *South*. This Stream was of a dusky red towards the *North*, but pale on the other side, and seemed to have a faint Mixture of the Prismatic Colours in it.

—at Petworth in Sussex. Oct. 8. 1726. by the Rev. Dr Langwith, No. 395. p. 132.

At the same time there appear'd a pale luminous Arch, whose Middle was nearly N. W. by N. The Altitude of it's inner Edge was about 18 or 20 Degrees. This Edge was very distinct and regular all above, but a little confused towards the Horizon, where it extended itself beyond the North-Point: How it terminated to the West, I cannot inform you. From the upper Side of this Arch, which was waving, and ill defined, there shot up continually such Streams of Light as have often been seen and describ'd, since the Great Meteor of *March* the 6th, 1716. The Sky under this Arch look'd exceeding dark, but was in reality clear; for we could see the smallest Stars in it.

Nearly N. E. there was another Stream of pale-coloured Light, which was about 7 or 8 Degrees distant from the Horizon, and was about as many in Breadth: It's Heighth was various, and ill defined. Towards the bottom of it, was an irregular black Cloud, which in some parts was near a Degree in breadth, in others hardly half



half so much : This Cloud was almost parallel to the Horizon. The Stream moved with a slow regular Motion towards the East.

In the S. E. was another Arch, like that in the N. W. by N. but not quite so high, or of so great an Extent. Between this Arch and the North-Easterly Stream the Sky was of an odd pale coloured Light, with a mixture of Red in it.

From the South towards the West were gloomy irregular Clouds, which now and then sent out Flashes of Light.

About 8, the North-Easterly Stream suddenly expanded itself every way : All its Parts began to be in a violent Commotion, and its Brightness increased to such a degree, that I remember nothing like it in the former great Meteor of this Kind. All above it was of a bright flame-colour ; but below, it was edged with the Prismatic Colours, which were full as strong as I have ever seen them in the brightest Rainbow : They were not indeed so distinct ; for, tho' I observed them as exactly as the strange variety of their Motion would permit, I could only distinguish the Red, the Yellow, and a dusky bluish-Green.

This surprizing Sight did not last above a Minute or two ; but when the Colours vanished here, they began to appear in the North-westerly Arch, which was now become a Portion of a larger Circle than before, and was not elevated so high above the Horizon. The Colours extended themselves from the North towards the West for about 15 or 20 Degrees ; and tho' they were not so bright as in the other Place, yet they were more steady, and so as easily observed. Their Order was the same as before, the Red lowermost, and so on : Their Duration much longer.

In the mean time the Streaming Lights began to appear in all Parts of the Heavens, and to form a *Corona* and Canopy, which were in all respects like those of the Great Meteor of 171 $\frac{1}{2}$ . Instead therefore of troubling you with a long detail of the Particulars of these, I shall refer you to the curious Descriptions of the other by the Astronomer-Royal, and my late worthy Friend Mr Cotes. I shall only take notice that the Colours of the *Corona* were neither so strong nor so lasting as those before described, and that the Top of the Canopy was sometimes over-spread with a deep fullen red.

The Streams continued their Direction upward towards a point of Concourse for a long time after, and formed by fits imperfect Circles of pale Light about it : This Point, however was not fixed ; for at first it seemed to be in, or very near our Zenith ; but when I observed it some time after, it lay between the Stars in *Andromeda's* Right-hand, and those at the end of her Chain. The same Observation was made by a curious Gentleman of this place, who also informed me that there was another luminous Arch which past quite thro'



thro' the Pole-Star : It's Continuance was short, and I had not the good Fortune to see it myself.

These Appearances held on in some Degree till about 11, when the Air began to grow misty, and so put an End to any farther Observations.

I cannot send you the exact Point of the Wind : It was so calm below, that I could not be certain which way it stood ; but some that were making their Observations from a high open Place, assured me, that it was North-Westerly, as it was in the Afternoon before, and the Morning after.

The Mercury was up at 30 : The Weather mild and temperate.

I shall venture to add, the following Observations,

Observations  
on this Phenomenon.

1. That it plainly appears from the Position of the Arches, that they could not owe their Figures to the Sun : They seem to have been partly Optical, and partly to have depended upon the different Heights of the luminous Vapours ; but for want of sufficient *Data*, it will be no easy matter to determine how far each of these Causes concurred.

2. The Prismatic Colours, wherever they appeared, seem to have been caused by the Sun.

3. None of the Streams, as far as I could observe proceeded directly from the Horizon. They were nearest it towards the North, where there were some weak irregular Lights in the confused Parts of the Arch before described.

4. I find by some of my Papers, that during the Meteor of 17<sup>15</sup>/<sub>16</sub>. the Mercury stood at 30.2 ; so that the two Meteors agree, as in many other Particulars, so in the following, viz. That the Air was calm, the Wind North-Westerly and the Mercury high.

I shall only add farther, that luminous Vapours in the Air are much more common than they are generally taken to be ; for the Nights are very often lighter when the Sky is over-cast, than in the brightest Star-light, though the *Crepusculum* be quite gone off and there be no Moon.

2. About half an hour past Six, perceiving *Jupiter* shone very bright I was applying my Telescope to observe him, when on a sudden several luminous Streaks appeared about 10 Degrees above the Horizon in the N. E. and the Hemisphere seemed much enlightened. Imagining this to be the beginning of a *Lumen Boreale*, I cast my Eye carefully along the Northern Horizon from E. to W. and very nearly in the W. Point I perceived, as it were, a vast red fiery coloured Obelisk shot itself up to the Height of 30 or 40 Degrees, which seemed perpendicular to the Horizon, and it's Base seemed to insist on it. It's Point almost touched the bright Star in the Northern Crown ; a smaller Column or two stood near it, of the

—at Ply-  
mouth, by  
Dr Huxham.  
No. 395. pag.  
137.



same Colour and Shape. The Light, in the mean time, to the Eastward increased considerably, and became more vivid; as when the Moon is behind a very bright Cloud. It also formed itself into Columns, which were projected to no great Height, and would soon vanish, then soon return, and appeared not only in the N. E. but also more Northerly.

In about a quarter of an hour from my first Observation, as from an Arch, or black Basis (I know not better how to express it) extended all over the Northern Horizon, which seemed to intersect it nearly in the W. and E. N. E. Points, arose abundance of pyramidal Columns of Light on all parts of it; now here, now there, of unequal Bigness, Height, and Lustre; now suddenly gleaming forth, then as suddenly disappearing; but those Columns, that were to the Eastward of the N. were more bright and lucid than those to the Westward, which were of a more fiery, rutilant Colour. The great Column in the *West* still remained in the same Position, Height, and Shape; as I observed, by applying my Eye to a Wall very near E. and W.

Between the Arch and the Horizon, appeared as it had been a black, dusky Fog, from whence the Streams of Light seemed every where darted forth: Yet however black this appeared, we could discern the Stars very clearly thro' it. This Arch at it's first Appearance seemed not to be above 15 or 20 Degrees (at it's highest part) above the Horizon; but it continually grew higher, and from all parts of it Cones of Light were every Moment shot up, which all seemed to tend to a Point near the Zenith (as the Vertical Circles or Arches on a Globe tend to it's Poles) tho' as yet none reached it by several Degrees.

After 7 a clock the Columns to the Westward appeared bright and vivid as those in the E. except those very near the W. Tho' the Limb of the Arch would seem sometimes very regular and well defined; yet at other times it would seem to sink, now in the middle, then at one part, then at another; and sometimes it would rise with the same Irregularity: But it was certain, that during the whole time of the *Phænomenon*, no Light, or flashes of Light did appear in the black *Area* included between the Arch and the Horizon; even when it was at it's greatest Height, which was about 10 or 12 Minutes before 8, when I judged it to be at least 40 Degrees above the Horizon. Then from all parts of the Arch, but first from the Northern or highest parts of it, were Rays, or lucid Columns of a surprizing Brightness and Lustre, darted with incredible Velocity towards the *Vertex*, where the Cusps of the converging Columns seemed nearly to centre; and suddenly from every Quarter of the Heaven, bright, shining Streams of Light were shot towards the Zenith; which meeting about 6 or 8 Degrees to the Southward of it, formed a small Circle of two or three Degrees Diameter, whose Border was much more lucid than



than near it's Centre: This Circle seemed formed between *Cauda Cygni* and the *Lizard*, then nearly upon the Meridian.

This beautiful *Spectrum* might be likened to the Star worn by the most Noble Order of the Garter, but the pyramidal *Radii* were here reversed; and from the Southward the Rays or *Striæ* were not near so long as those from the N. especially those from the due S. not reaching above 10 or 15 Degrees from the Centre or Circle; whereas those from the Eastern and Western Quarters were very long, and reached almost down to the Horizon; especially in the E. and W. Points. The *Radii* were in a continual and exceedingly swift Undulation, and appeared of several very bright Colours, as white, red, green, yellow, for several Seconds; but the most permanent and predominant Colours were a fiery red, with an Eye of Crimson, and a bright Pearl Colour: The red Rays came mostly from the Westward, and that Colour continued till the entire Dissipation of this radiant Canopy; the others dying away and leaving, as it had been, a thin Smoak. The Vibrations of these radiant Columns were as swift as Flashes of Lightning, and incessant.

This surprizing Sight remained over us in it's full Glory 3 or 4 Minutes, during which time the Rays were darted towards the Centre with prodigious Swiftnes, and did not seem to be shot from it. Sometimes they undulated like the Vapours arising from a Lime-Kiln, or from the Earth in very hot Weather, and all the upper part of the Hemisphere seemed to be, as it were, in a Convulsion.

In a short Time this agreeable Scene vanished, and was broken into small flitting bright Clouds, which still retained an undulating Motion; and Coruscations would every now and then break forth from them. At this time also I observed several Star-like Meteors fall, as is frequently observed in a bright serene Night.

Tho' our glorious *Cupola* disappeared a very few Minutes after 8, yet very vivid Coruscations were shot continually from the N. E. and N. W. Parts of the Heaven, which dashing against one another near the Zenith, formed by their Collision momentary Arches of a Circle, nearly in the same Place and of the same Diameter with that above-mentioned. None now proceeded from the *South*, and very rarely from the true *North*. The Coruscations were always more red and fiery from the Westward than from the *East*, which were always more bright and luminous.

We were lost in the Contemplation of the beautiful *Phænomenon* over our Head, and did not observe the Formation of a lucid Arch projected over all the Northern Horizon, which seemed like the Arch of a Rainbow, of one vivid, bright, yellowish Colour, and all under was as it were, a very dark Cloud; tho' by viewing it with a Telescope, we could discern the minutest Stars: So that the Darknes only proceeded from the greatness of the Light just above it. From this, as from the former, arose very lucid, bright Columns on all parts of



it. No Coruscations appeared under it. It's greatest Height might be 20 or 30 Degrees. Some of the Columns seemed to radiate even to the Zenith from this Arch.

About 9, this lucid Arch vanished insensibly, with most of the luminous *Radii*, or Columns; but, as it were, a very bright *Crepusculum* still remained all along the Northern Horizon, and several very bright Coruscations would seem to be shot out of the pure Sky: This, more especially, was observed in the N. E. About 11, I observed several Coruscations still breaking forth, and here and there a luminous Column; and several little bright Clouds seemed irregularly scattered up and down the Hemisphere, which still retained their darting and quivering Motion. The Northern *Crepusculum* remained as bright as ever, and so continued till past Two in the Morning.

There were but very few, and those very small, Clouds to be observed during the whole time of this *Phænomenon*, and the Air was clear; yet all around, and between the lucid Columns, whenever, or in what part soever, they appeared, the Air would seem very thick and hazy; tho' immediately upon the disappearing of those gleaming Lights, the Sky would in the same Place appear very clear and serene. Nay, even thro' some of the very Columns we could plainly discern the Stars. Some Gentlemen thought they saw the bright Stars of the Swan thro' the *Corona* itself.

As to the Weather preceding and following this *Phænomenon*, I need not be very particular, seeing you will soon have it in my Meteorologic Observations. The Morning was fair, tho' the Air was thick, and we had a great Dew: The Mercury was at 30 Inch. *Hawksbee's* Thermometer at 50, little, or no Wind. The Day was pleasant and warm, and the Air grew much thinner. The Evening was serene; a very soft Breeze from N. and by W. About Five the next Morning, there were several Clouds formed, and the Air was very thick and hazy, at Seven it was all Cloudy, and a few Drops fell.

Tho' I had before seen several faint Appearances of the *Aurora Borealis*; yet this, for Beauty, Lustre, and Duration, vastly exceeded any thing of that nature I had ever seen. Indeed, I saw not that of *March* 6th, 1716, being not then in *England*.

—at Exeter,  
by Dr Hallet,  
No. 395. P.  
143.

3. *October* 3, 1726, at Nine in the Evening, I saw an *Aurora Borealis* (as 'tis commonly called,) in which there was nothing different from former Appearances, excepting that from the luminous Arch which appeared in the *North*, were frequently shot off Parts of Arches towards the Zenith, which vanished there.

*Octob.* 8, Coming from the Country near Seven in the Evening, I observed a great Light in the *East* and *West*, which soon extended itself over our Heads, the *North* and *South* appearing dark at the same time. No Cloud was seen all that Day. A great Dew fell on a sudden, with which the Streets were wet, as by a small Rain. Half  
an



an Hour after Seven many Streams appeared in the *North*, which grew very bright, and darted frequently up to the Zenith. A Line drawn through the Bases of them, made an Arch of a Circle, extending from the N. E. to the W. or S. W. But the Streams seemed to proceed from a clear Sky being distinct from one another at the Bases, and not united by a luminous Arch or Cloud, as in the more usual *Aurora's*. The Streams at the two Extremities of the Arch were brighter, wider and longer when they did not shoot, than those on the Top of it. There was at the same time a luminous Arch extending itself from the two Extremities of the above-mentioned *Aurora* through the *South*, at a considerable Altitude. About Eight o'clock the Streams began to have a Horizontal Motion, propagating themselves on both sides towards the *South*; and in a Minute or two the whole Heaven was surrounded with them. Immediately they all extended themselves up to a Point near the Zenith (I think, a little towards the *East*) where their Points were blended together in a confused manner. At the same time, every Stream, which before was white, appeared striped with all the Colours of the Rainbow; but the most prevailing Colour was a deep Red. It is impossible to express the Beauty of this glorious *Umbrella*, which covered the whole Hemisphere with it's variegated Rays, the Colours of which succeeded one another in a regular Order. In the Center of these Rays was a confused Rolling, Agitation or Ebullition of a luminous Cloud, appearing like Smoak. In about ten Minutes (as I imagine) the Colours disappeared, and the Streams began to retire from the Zenith; presently after which, they would frequently dart and shoot with great Celerity up to the same Point. This Darting and Flashing, together with a tremulous Motion from all sides of the Horizon, I observed till 12. And I am informed by others, that it continued till Four in the Morning. The most considerable Rays came from the *East* and *West*. Next Morning we had a Fog.

Fig. 14.

The best Account which I can give of this *Phænomenon* is this: I *Cause of this* imagine a thin Cloud composed of a Sulphureous Exhalation, hang- *Phænomenon.* ing over us in the Air, at a considerable Height, parallel to the Horizon; the Length of it being very great from *East* to *West* nearly; the Breadth of it (at first) not so great, but that we might see the Stars from under it to the *North* and *South*. The North-Side of it, I suppose, first took Fire, and shot it's Streams or Flames perpendicularly upwards, which being undisturbed by Winds, must appear straight and pointed at the Top. The Bases must make an Arch by the Rules of Perspective: For, I think, an Horizontal Right Line, of a vast Length, and at a great distance from us (such as I take the Northern Edge of this luminous Cloud to have been,) seen at a considerable Height in the Air, must appear bent down into an Arch. On a sudden the Fire propagated itself to all parts of this Vapour: The whole Heaven must then appear covered with the same Streams which.



which tho' really parallel to one another, must appear bent into a *Cupola*. The shooting and darting of these Flames, and their Concourse, together with a Smoak proceeding from them, must give that confused Cloud which was observed in the Center of this Canopy. The regular Disposition of the Colours in every Stream, perhaps, you may account for. I think, the red appeared at the right hand in all of them. Somewhere in the *Philos. Transact.* I have met with an Observation of an *Aurora*, in which the Streams were coloured only where they met, or crossed one another. Whether the Light of one Stream passing thro' another, may not be separated into Colours by Refraction, I will not determine. You may think of a better Solution. If the Altitude of the Top of the Arch in the *North* had been taken here, and at the same time at another Place upon the same Meridian, whose distance is known, from thence I imagine, the Height of the Cloud (as I call it) might have been calculated.

—by John  
Hadley, *Esq*;  
*F. R. S.* N<sup>o</sup>.  
895. p. 146.

4. The *Royal Society* hath received so many and so full Accounts of the frequent Northern Lights, which of late Years have been seen in *Europe*, and particularly of that remarkable one of the 8th of *October* last, that it seems needless at present to give a minute Description of the whole Appearance. I shall therefore only take notice of a few Particulars, which either have been omitted by others, or by some remarkable Circumstances attending them, seem most likely to be of use to those who employ their Thoughts in attempting to discover the Nature and Causes of these *Phænomena*.

The first Sight I had of this Appearance, was about half an Hour after Seven of the Clock ; at which time it had nothing remarkable to distinguish it from those others which had been observed almost every Evening for some time, except a dusky redness arising from the Western Extremity of the luminous Arch ; and that at the same time there was seen another like hazy Arch low to the Southward, fainter, but more steady than that to the *North*. I judged the highest Point of it to be something more elevated than the Sun at Noon about the Winter Solstice.

In a short time after, the Northern Arch was risen considerably higher from the Horizon, and continued to advance towards the Zenith, till 8 ; when in one part it passed among the uppermost Stars of *Cassiopeia*, and in another close below the bright Star in the *Harp*. The Heavens underneath looked clear, and of a dark Blue, having no resemblance either of Dawn or dusky Cloud, and the Pyramids of Light seemed to spring immediately out of the pure Sky. The Arch itself was very irregular, being full of Notches, some greater, some less. The dusky red on the *West* was changed to a light Crimson, and was answered by the like Colour on the *East*. The Rays issuing from both Extremities, were thick and bright, appearing as if there were several, one behind another. They were also generally longer than the rest, and pointed considerably to the *South*  
of



Fig. 9.

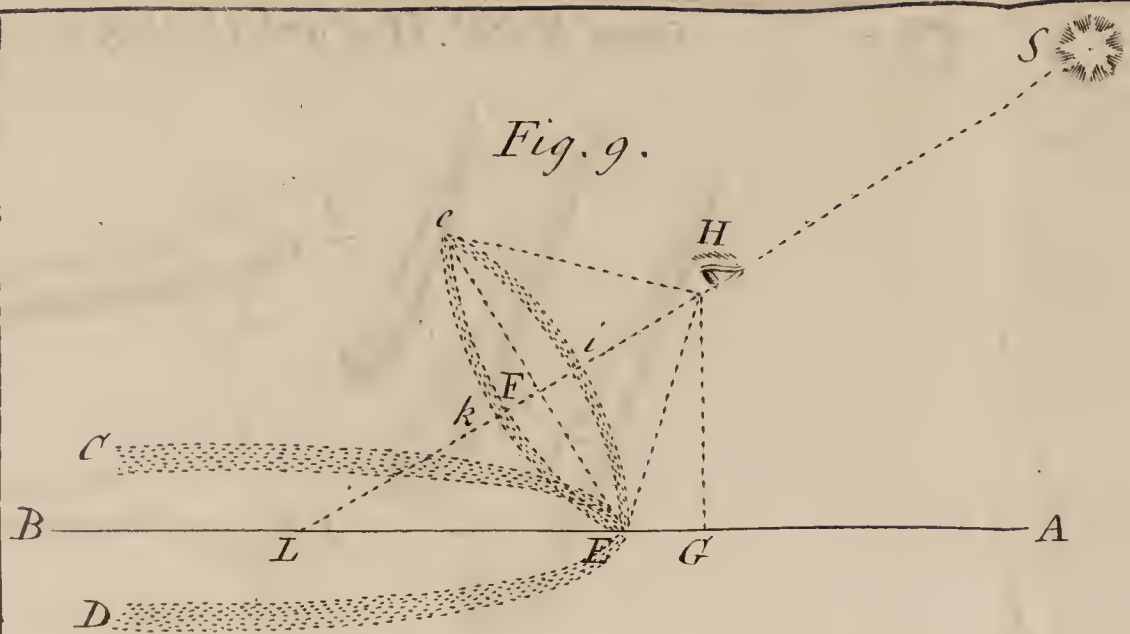
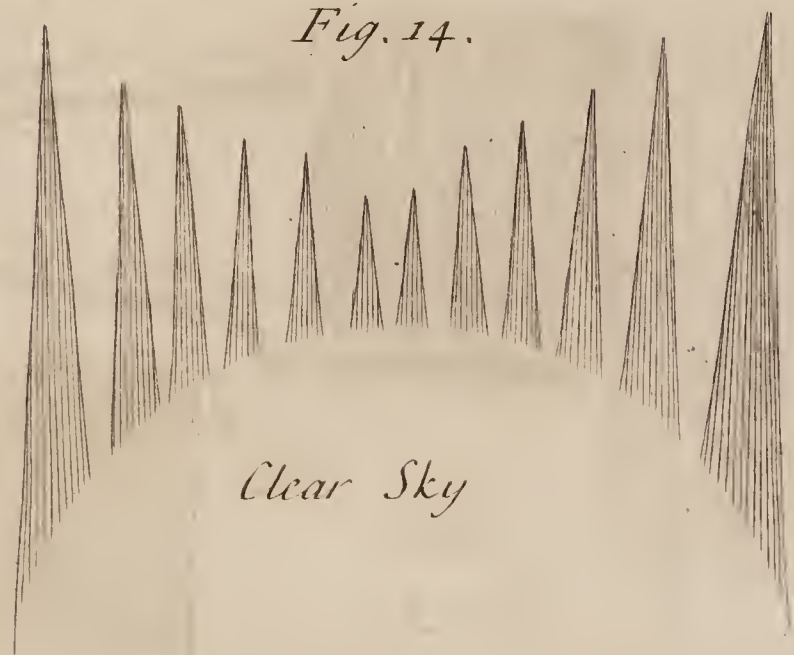


Fig. 14.



Clear Sky

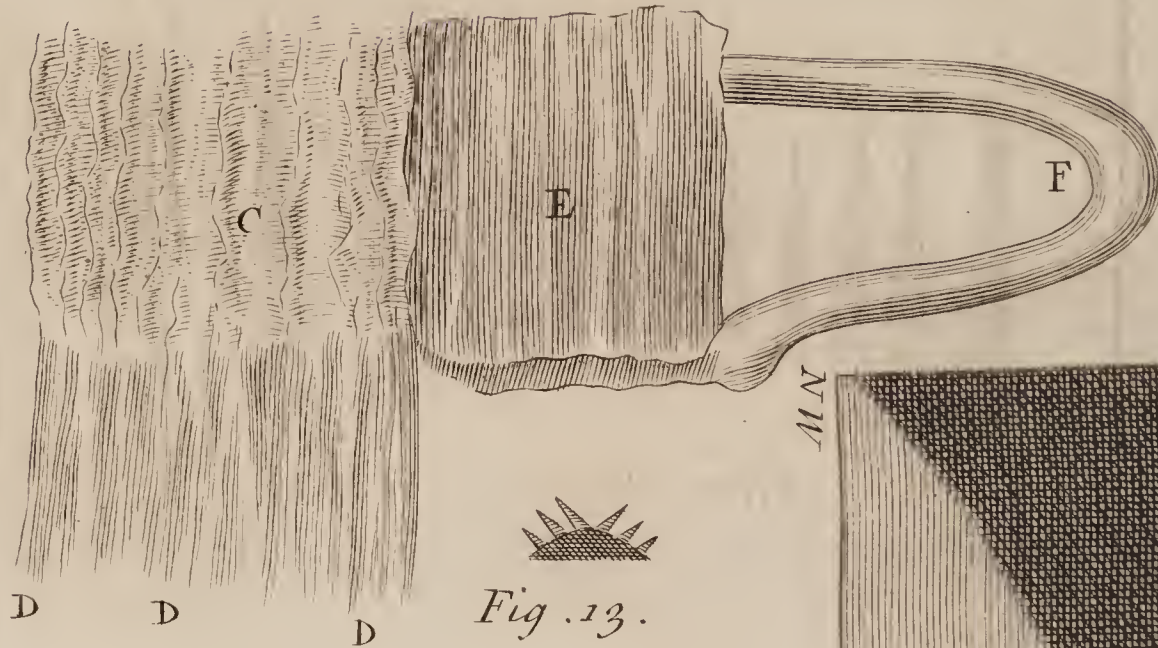


Fig. 13.

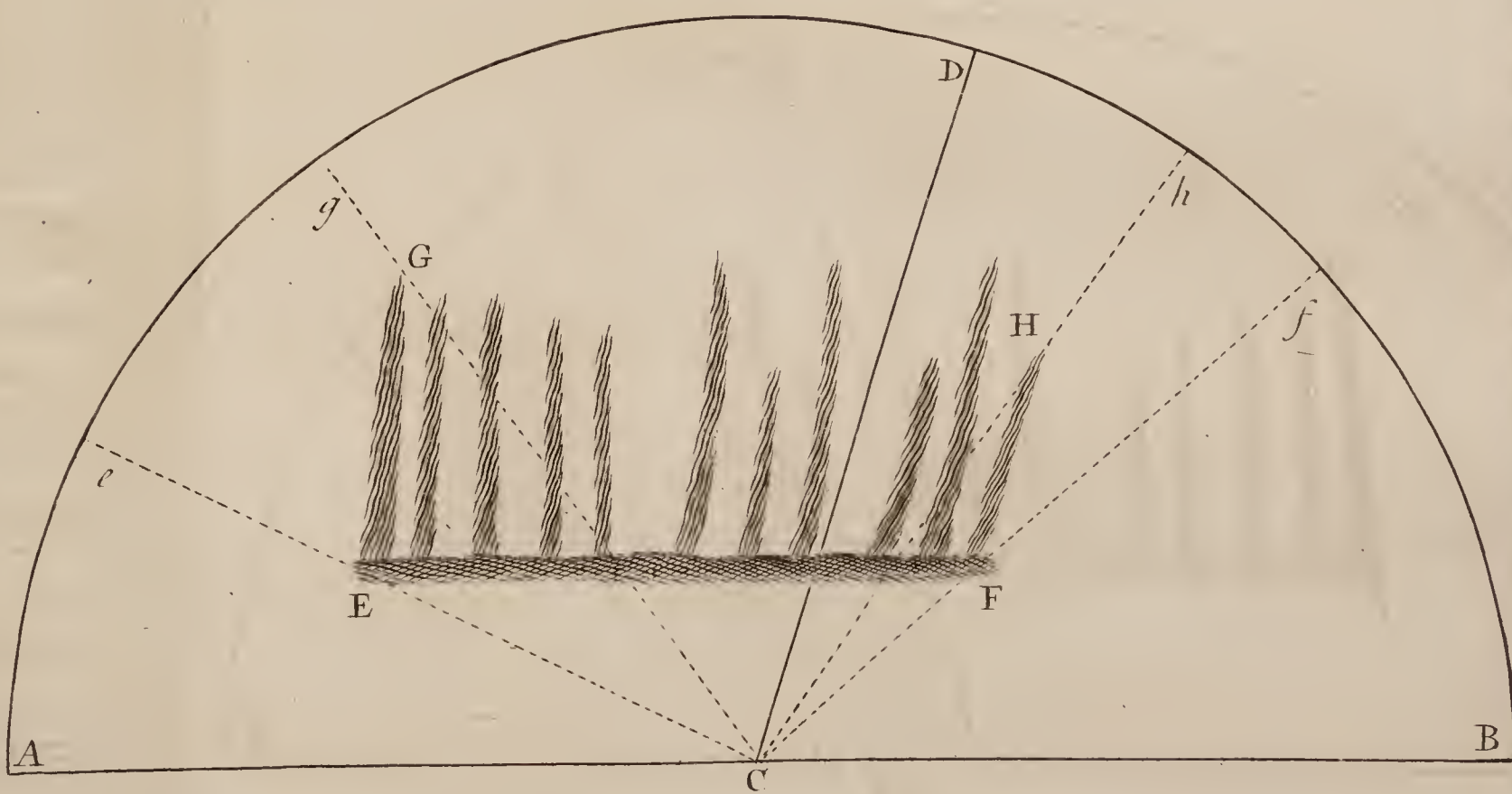


Fig. 11.

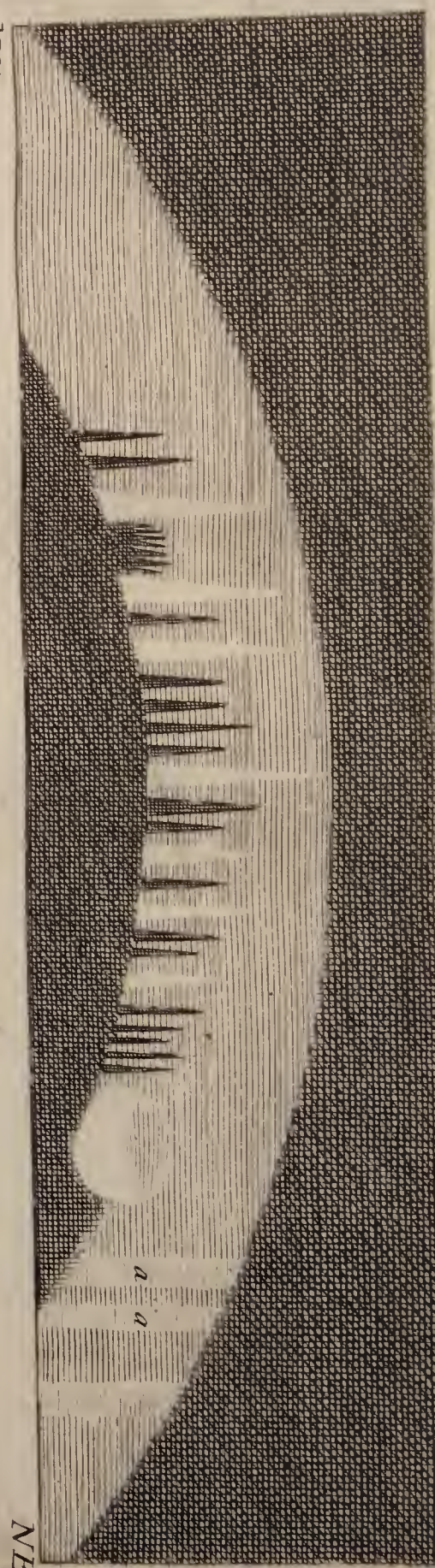
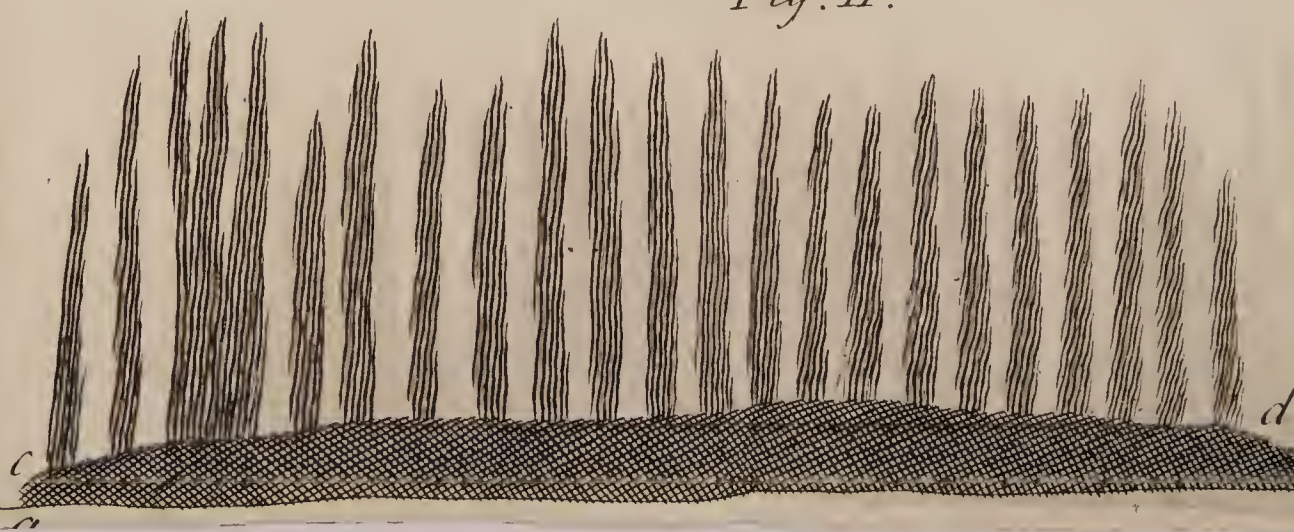


Fig. 12.







of the Zenith. After 8, the Northern Arch retired again downwards, till it came among the Stars of the *Great Bear*: when the whole Scene was changed on a sudden, and Rays were darted up from all sides, and formed that Crown-like, or Star-like, Figure which has been sufficiently described.

The intermediate *Area* (left between the innermost Extremities of the Rays coming from different Quarters, which very rarely, if ever, joined) was of an irregular Figure, commonly inclining to an Oval, whose longest Diameter lay *East* and *West*. Sometimes it appeared as clear Sky, at other times was filled with a thin white Cloud, and that Cloud was often divided into two Parts, by an uneven crooked Line, running likewise *East* and *West*.

The Rays which immediately surrounded this void Space, were of no great Length, and very unstable: Yet two or three times, when they continued steady enough to afford an Opportunity of considering them attentively, their outermost Extremities were sensibly carried Southwards, the Center itself remaining, to appearance, fixed.

The Southern Quarter was filled with continual Flashings of Light. These followed one another very quick, and were propagated upwards from the afore-mentioned Arch with great Swiftnefs, each of them leaving in some parts of the Space it passed through, a faint, and very transient Whiteness, which presently vanished, and was quickly renewed, usually in the very same Track, by the next succeeding Flash. Yet none of those Tracks were in any degree direct and uniform; but all very irregular and broken.

The Central Figure sometimes disappeared for a while, and then returned again. Whether it always retained the same Situation with respect to our Horizon, I cannot depend on the Exactness of my Observations enough to determine. They were as follow:

About half an hour past Eight, the Center, as well as I could judge by my Eye, was very near a Star of the fifth Magnitude, placed by *Hevelius* at the End of the *Lizard's* Tail, whose present Right Ascension is about  $331^{\circ}$ , and Decl.  $36^{\circ}$  and an half N. At Nine, it was at the Northern Point of an *Isoceles Triangle*, whose Base was a Line joining the Star in *Pegasus* Shoulder, called *Scheat*, and the brightest of those in his Knee; the Perpendicular from the Center being in proportion to the Base, about as 3 to 2. At 9 h. 15<sup>l</sup> the *Triangle* made between that and the two forementioned Stars was become right-angled at *Scheat*, the Distance being not much altered. At Ten, it was directly between the Zenith and *Andromeda's* Head at a Distance from this Star not sensibly different from what it had kept from the Northernmost of the two forementioned.

According to the first of these Observations, the Central Point must have been very near the Meridian, and about  $15^{\circ}$  South of the Zenith of the Place where I was; which is a few Minutes directly North from *London*. The three last agree pretty well with one another,



another, to carry it between 2 and 3 Degrees further Southward, and to give it a perpendicular Distance of 3 or 4 Degrees of a great Circle from the Meridian Eastward.

In the remarkable Appearance of this kind which happened the 6th of *March* 17 <sup>$\frac{15}{16}$</sup> , I observed the like Center at near half an hour after 7 o'clock, to be something nearer the Zenith, than the bright Star in the Northern Head of the *Twins*, and to be more Easterly by about half the Distance between that and the Star in *Pollux's* Head. By comparing this Observation with the Situation of the Star at that time, the Center appears to have been about 16 or 17 Degrees from the Zenith, and about 2 or 3 distant from the Meridian Circle towards the *East*.

— at Geneva,  
by Joh. Lud.  
Calandrini,  
Math. Prof.  
Ordinar. No.  
395. pag.  
150.

5. Die Saturni <sup>12</sup>/<sub>8</sub> Mensis Octobris, horâ sextâ & dimidiâ vespertinâ, Aurora Borealis fulgere cœpit, Phænomenon vobis quidem satis familiare, nobis verò ex seniorum sententiâ plane novum, sed tam illustre, & circumstantiis à vulgaribus in Transactionibus sæpe descryptis tam diversum, ut de eo audiisse fortasse non pigebit.

Primò quidem, quâ horâ dixi, Arcus lucidus visus est, cujus medium stabat in Horizontis Septentrione, extremitates ad Arcturum in Occasu, & ad Pleiades in Ortum, 40° altus; lucidus satis, ut Solem è Septentrione jamjam ortum ire diceret; sed hic nihil est novi.

Post horam septimam, quasi violenti incendii flammæ, vel continua fulgura totum albicantis arcus locum occupaverunt. Serpebant ex Horizonte ad cœli fornicem haud absimiles veri furni flammis, extremitates arcûs rubicundo atrove fulgore vulgum terrebant, ipsæ flammæ in atrum fumum desinere videbantur, ita ut diem Domini instare mulierculæ non dubitarent. Cœleste hoc incendium plusquam horam duravit; Scenâque mutatâ, ex Horizonte exilire columnas, quæ ad Zenith pertingerent, visum est: Ex eâdem supradictâ basi, coronâ in extremitate Phænomeni tum occidente & cornu Tauri inferiore ab alterâ parte surgente, columnæ plus minusve latæ, 60 aut 70° altæ, tria vel quatuor minuta durantes, paulatim evanescentes, vel prius in igneum colorem versæ; post aliquod tempus cessarunt columnæ: tum Aurora Borealis ut primum fulsit, cui ante decimam successerunt flammæ vehementiores quam prius, quibus cessantibus columnæ circa undecimam visæ sunt, magis diutinæ, & 120° plerumque altæ: Rursus Aurora, mox flammæ, postea columnæ, atque ita ad tertiam usque, quâ videbantur adhuc Phænomeni reliquiæ.

Ultra luculam, quæ semper Septentrionalem, quam dixi, cœli partem illustrabat, majoris Ursæ stellæ parum fulgebant. E Vespertio, quod 90 miliaribus hinc distat, eodem modo visum fuisse Phænomenon accepimus.

Arfit interea unum ex illis Meteoris, stellæ cadentes dictum, quod ultra Phænomenon arfisse visum est.

Ex reflexione Solaris luminis à partibus Atmosphæræ Borealibus congelatis Auroras Boreales formari dictum est: Sed flammæ adeò notabiles



notabiles quo pacto explicentur non video. Si ab exhalationum incendiis ortum hoc Phænomenon censeatur; Aurora Borealis Phænomeni comes, columnæ, duratio Phænomeni, & ipsius in eodem loco statio, negotium faceffent.

6. For the clearer proceeding in my Relation, I shall observe, that there are two sorts of *Streamings*, which I have taken notice of; one, by way of *Explosion* from the Horizon; the other, by *opening* and *shutting*, without Shootings up, and swift Dartings.

—by the Rev.  
Mr Derham,  
F. R. S. N<sup>o</sup>.  
398. p. 245.1

Of the latter sort chiefly, was that of Oct. 8: in which, altho' the *Streams*, or *Spires*, or *Lances*, or *Cones* (or, what shall I call them?) were as large and remarkable as in that of the Year 17<sup>15</sup>/<sub>16</sub>; yet they exhibited themselves principally by the vaporous Matter opening and shutting, as if a Curtain had been drawn and withdrawn before them.

The first View I had of this *Phænomenon*, was precisely at Eight o'Clock in the Evening: At which time, all I saw, was a long narrow *Fascia*, like a white ragged Cloud, extended cross the Heavens, from W. b S. to E. b N. which in a few Minutes began to emit some *Streams*, and then disappeared; Which was succeeded by much Streaming in the Northerly Parts; and in a quarter of an Hour it began to reach other Points also; and soon after that, it streamed all round in the Southerly, Easterly and Westerly Parts as much, or nearly as much as in the *North*. Which was a thing I never had seen before in these *Phænomena*.

These *Streams*, or *Cones*, were for the most part pointed, so as to make the Appearance of *flaming Spires*, or *Pyramids*; and some others were truncated, and reach'd but half way: Some also were longer, and some shorter; some of which had their Points reaching up to the Zenith, or near it, where they formed a sort of *Canopy*, or thin Cloud, sometimes red, sometimes brownish, sometimes blazing as if fired, and sometimes emitting *Streams* all round it, which at that time gave it the Appearance of such a Star as our Knights of the Garter wear on their Breasts.

This *Canopy* was manifestly formed by the Matter carried up by the Streaming on all parts of the Horizon: Which Matter sometimes seem'd to ascend with some force, as if impell'd by the Impetus of some explosive Agent below, as I have said it was in the Streaming of March 17<sup>15</sup>/<sub>16</sub>, and which I gave the Society a large and particular Account of soon after. This forcible Ascent of the streaming Matter, gave a Motion to the Canopy, sometimes a Gyration, like that of a Whirlwind; which was manifestly caused by the Streams striking the outside Parts of the Canopy, as in the Figure: But when the streaming Matter hit the Canopy in the Middle, all was then in Confusion.

Solution of this  
Phænomenon.

These two Particulars, namely, the *Streaming all round*, in all Points of the Horizon; and the *Canopy* in and near the Zenith, are



what were taken notice of in all Parts of *England*, that I have met with any Accounts from ; particularly, in *Northamptonshire*, *Staffordshire*, *Oxfordshire*, *Wiltshire*, *Berkshire*, *Middlesex*, *Somersetshire*, and *Effex*, and in divers Parts beyond Sea.

Mr Wasse's  
Account, from  
Aynho in Nor-  
hamptonshire.

The Reverend and Learned Mr *Wasse* gives me this Account of it's Appearance at *Aynho* in *Northamptonshire*, That at 7 h. 20<sup>l</sup> p. M. he saw an Arch somewhat curved, like a Rainbow at first, and about half the Breadth of the Rainbow, and yellow ; which in about ten Minutes began to twist, and make an Angle at the Zenith : That one End of it was pretty much to the East, and not directly to the North ; and the Western End deflected as much to the South : That it remained after the Twist, at the Zenith, without any great Motion, not a quarter of an Hour. After which, the Rods arose on all sides, from the Horizon to the Zenith, the upper Points seeming to move thro' a sort of Vortex quite out of our Atmosphere : Which Rods, he thinks, rose perpendicularly from the Horizon, but seemed to converge towards the Zenith, according to the Rules of Perspective, by their Angle then being less than their Basis at the Horizon : That a Redness was perceived, which, he thinks, was strongest towards the West ; which Colour did not appear till the Arch brake into several Pieces, and overspread the Heavens with a thin faintish Fire, thro' which they saw *Jupiter* very clearly.

Account from  
Scaffhausen.

This Account of Mr *Wasse*'s may shew, how the Phænomenon was in *England* ; by reason most of the Accounts I have met with concur in the main with his. But in the more Southerly Parts of *Europe*, I take it to have been somewhat different. The News-Papers tell us from *Scaffhausen*, “ That on the 19th of *October* there was a great Alarm in many Parts of *Switzerland*, on Account of a great Light seen in the Air, from 7 o’Clock till Midnight ; which was supposed to be the Reflection of some great Conflagration. At *Bern*, every body thought there was a Fire in some part or other of the City or Neighbourhood. At *Neufchatel*, the Alarm-Bells were rung, and the Governour several Hours on Horseback, to give Orders, &c. as in Cases of Distress. All which they heard afterwards, was only an *Aurora Borealis*”. And from *Florence*, my in-

— Florence  
by Sir Thomas  
Derham.

genious and curious Friend, Sir *Tho. Derham*, sent me this Account. “ As to the *Lumen Boreale*, which appear’d in these Parts on *October* the 8th last, I saw it my self in the following manner : It was one Hour and half after Sun-set, when I was passing thro’ a Piazza in this Town, that I discovered the Phænomenon, that seem’d one Mile long, and three quarters of a Mile broad, of an almost perfect Oval Figure, hanging North and North-East to us : The Edges of it were of a pale light Colour, like the first Dawn of the Morning ; and towards the Center, it encreased it’s fiery Colour ; so that in some Places it looked as the Fire of a Furnace ; but in the very Center, and many adjacent Parts, it was like a red-hot

“ Iron



“ Iron growing cold, that seems bloody. For a good while I could  
 “ perceive no Motion in it ; but after a quarter of an Hour, I dis-  
 “ covered a general slow Motion backwards and forwards, like that  
 “ one sees of the Circulation of the Blood in the Tails of Fishes,  
 “ by the help of the Microscope, but no manner of darting ; in-  
 “ somuch that in another quarter of an Hour it vanished impercep-  
 “ tibly, just as a Rainbow, and the Air grew dark again, that was  
 “ so luminous before, that one might read a Manuscript by the same.  
 “ It is very remarkable, that at *Fiesole*, a Town within a short Mile  
 “ of this, the Phænomenon seemed to those Inhabitants, to be be-  
 “ tween them and us, and they thought our Town was burning :  
 “ Whereby it appears not to have been very deep, nor very high ;  
 “ *Fiesole* standing upon a Hill half a Mile high, and to the North-  
 “ North-East of this Town.

To these Observations of myself, and some of my Correspondents, I shall add two or three things more, before I enquire into the Cause of the Phænomena. *Some farther Observations.*

One thing that was taken notice of in most Places, was, That in some part of the greatest Streaming, the Vapours between the Spires, or Lances, were of a Blood-red Colour. That which I observed, was, That about half an Hour after Eight o’Clock, the Vapours towards the South-West were very dense, and for some time red. And not long after, the like Redness arose in the North-East, and the other gradually went off. Both which gave those Parts of the Atmosphere the Appearance of blazing Lances, and bloody-coloured Pillars.

Another thing I took notice of, was, a strange Commotion, and working among the Streams, as if some large Cloud, or other Body was moving behind them, and disturbed them.

In the Northerly and Southerly Parts the Streams were perpendicular to the Horizon ; but in the intermediate Points they seemed to decline more or less one way or other ; or rather to incline towards the Meridian.

As for the Weather, the preceding Day was cloudy, with an Hoar-Frost in the Morning ; but it cleared up, and grew warmer afterwards ; but towards the Horizon, very vaporous. And the next Morning (after the Streaming) before Sun-rising, the Air was full of Vapours, with divers thin vaporous Clouds, some of a lucid brown, some reddish, which I took to be Remains of the Streaming ; which, I was informed, continued all Night.

As for the Cause of these Phænomena, I take it to be from the same Matter, or Vapours, which produce Earthquakes : And that for these Reasons : *First*, Because some of these Phænomena have been followed by Earthquakes. As that which *Stow* gives an Account of in his Annals. in the Year 1574, on November 14, in which he saith, *were seen in the Air strange Impressions of Fire and Smoak to proceed forth of a black Cloud in the North towards the South.* That the



next Night following, the Heavens from all parts did seem to burn marvellous ragingly, and over our Heads the Flames from the Horizon round about rising did meet, and there double and roll one in another, as if it had been in a clear Furnace.

And after this (he tells us) followed on the 26th of February, great Earthquakes in the Cities of York, Worcester, Gloucester, Bristol, Hereford, and in the Countries about, which caused the People to run out of their Houses, for fear they should have fallen on their Heads. In Tewksbury, Breedon, &c. the Dishes fell from the Cupboards, and the Books in Mens Studies from the Shelves: With more to the same purpose.

So this last (in October) was preceded by that fatal Earthquake at Palermo in Sicily, and succeeded by one in England, on Tuesday, October 25, following. This, I hear, was perceived in London, and was very considerable at Dorchester, Weymouth, Portland, Portsmouth, Purbeck, and divers other Places in Dorsetshire, that it caused the Doors to fly open, shook down Pewter off the Shelves, and was felt in some Ships that lay in the Harbours.

2. Another Reason is, That I am assured by an ingenious sensible Gentleman of my Acquaintance, that as he was viewing this Appearance, on the Top of his House at Little Chelsey, he plainly perceived a sulphureous Smell in the Air; and that another Person did the same, on the Top of another House near him.

3. Another thing which concurs with what hath been said, is, That I am assured from several Persons, that an hissing, and in some Places a crackling Noise was heard in the time of the Streaming, like to what is reported to be often heard in Earthquakes.

And now, for a Conclusion, I shall remark two things upon what hath been said.

1. That it may help the sagacious Meteorologist to resolve several Difficulties relating to these *Northern Lights*, to observe, that what was *Streaming* or *Darting* in our Northern Parts, was only a remarkable Light, or Blaze in *Italy*, and the Southern Parts, if I take Sir T. Dereham's and the News-Papers Accounts right.

2. If those Phænomena have the same Origin that Earthquakes have, that then they are, doubtless, of great use to the Peace and Safety of the Earth, by venting some of that pernicious Vapour and Ferment that is the Cause of those terrible Convulsions, which Earthquakes are accompanied with.

I forgot (when I described the *Canopy* or *Corona*) to say, that it did not rest in one place; but changed it's Position, sometimes higher near the Zenith, and then towards the East, and South-East, 10 or 15 Degrees, and then back again nearer the Zenith, according as the darting Matter directed it: But I do not remember, that this Canopy was at any time directed towards the Western Points.

In most of the *Northern Lights* that I have seen, there generally was a dark Bank of Vapours, circular on the Top; but whether this



of Oct. 8, had any such Arch, I could not see at *Upminster*, where I was surrounded with Trees.

7. Octob. 8, 10, { Barom. Alt. } { Therm. } { Wind. } Weather fair —at South-  
Morn. { 29. 90. } { 54. } { W. 1. } and clear. wick in

This Evening appeared an *Aurora Borealis*, I think, full as remarkable as that in *March* 1716, tho' varying in Form: It began about Six at Night to be light in the North, with Streaks proceeding from it, and spread gradually both towards the East and West, the South being still very clear; but before Seven it left all the Northern Parts (except towards the Zenith) and covered all the Southern. Soon after which, there appeared a white Arch proceeding from East to West, passing near the Zenith, but more South, which seemed fixed for a time; but about 10 Minutes past Seven was dispersed, and immediately succeeded by a kind of Glory of an Oval Form, the longer Axis from East to West, something South of the Zenith, with Rays shooting up from all parts, and interchanging swiftly, for about 15 or 20 Degrees from it; the rest of the Heavens (except the North, which still continued very clear) affording various Phænomena. In the East there was a quick Succession of Columns of the *Iris* Colours, inclinable to White, the West to Purple, and about the South-West, for a good space, appeared almost a blood red Coruscation, which continued 5 or 6 Minutes. Northamp-  
tonshire, by  
George  
Lynn, Esq;  
No. 398. p.  
253.

These Appearances in a quarter of an Hour became less remarkable; though the *Aurora* continued most of the Night, and afforded a Light generally equal to the Moon in it's Quadratures. Looking with my Telescope at *Jupiter*, I found both his Satellites and Belts appear as plain thro' the *Aurora*, as if the Sky had been perfectly clear.

8. Monf. Gaudin, in a Letter from the Observatory at *Paris*, dated Octob. 20. N. S. 1726. writes, that he saw it first at half an Hour past seven in the Evening, forming at that Time a luminous Arch (with another somewhat darker under it) which extended itself almost from *Sun-set* to *Moon-rise*, and was raised above the Horizon about twenty five Degrees; from whence shot out from Time to Time luminous Streams about ten Degrees above it. At half an Hour past eight, the Number of these Streams vastly encreased, covering all the Heaven, excepting the Height of twenty Degrees opposite to it: But towards the Zenith there remained a circular Space which was never covered by them, tho' there wanted not a constant Succession. These Appearances continued very strong till half an Hour after ten; when they began to decline, and disappeared totally about two in the Morning. —by several  
Persons No.  
402. pag.  
453.  
—Monf. Gau-  
din at Paris.

Monf. Maraldi, in a Letter dated at *Thiers*, Oct. 20, 1726. N. S. two Leagues to the South of *Paris*, says, it began there about half an Hour past six with a constant uniform Light in the North; soon after which appeared three or four luminous Arches one over another, —M. Maraldi,  
di, at Thiers.



another, from whence issued a great Number of Rays, which shot up a considerable Height above the Horizon. At eight o'Clock these Rays darted quite up to the Zenith; half an Hour after which they very much encreased, spreading with strong Undulations all over the Sky, and all terminating in the Zenith formed a Sort of *Cupola* there. The Conclusion he has not observed.

—Sig. Quarantotti,  
from Treggiaia.

Sign. *Francesco Quarantotti* writes from *Treggiaia*, Oct. 20. 1726. N. S. that he first observed it a little before eight in the Evening, when it extended itself along the North Horizon about eighty Degrees, and reached above it about eight. After some time, the luminous Emissions began to rise perpendicularly, and continued from time to time so to do, from nine till eleven. About ten it enlarged itself fifteen Degrees farther East, and stretched under the last Star in *Ursa major*. At eleven it vanished.

—anonymous  
Account, from  
Florence.

An anonymous Account in *Latin* from *Florence* informs us, that it was first seen there at half an Hour past six in the Evening, with a clear expanded Light, occupying all the Space betwixt the North-East and North-West. At seven it divided itself into several spherical Triangles near the Horizon, which half an Hour afterwards united into one large Triangle, whose Base was near the Horizon, and extended twenty Degrees to the West from the North-Pole, and whose *Vertex* reached up to *Ursa minor*. This continued about half an Hour, and then disappeared; but at ten o'Clock it returned much more conspicuously, forming about the *Pole*, a large Column which was raised thirty Degrees above the Horizon. From this Time it emitted lucid Undulations till Midnight, when it entirely dispersed. He afterwards takes Notice that the same was seen at *Milan* and *Bologna*; the Accounts from whence agree, that none of the Streams reached beyond the Zenith.

—Sig. Manfredi, from  
Bologna.

Sign. *Manfredi* writes from *Bologna*, Jan. 3. 17<sup>26</sup>/<sub>27</sub>, that he did not observe this Phenomenon himself, but was informed that it was seen every where in the *Campagna di Roma*, as far as *Pesaro* and *Fano*.

—Dr Burman,  
from Upsal.

To these Accounts, which were communicated to the Society by their worthy Associate Sir *Thomas Dereham*, and most of them translated from the *Italian* by the ingenious Dr *Scheuchzer*, it will not be improper to subjoin, that Dr *Ericus Burman* in the *Act. Literar. Suec. Trimest. prim.* 1727. takes Notice, that altho' this *Meteor* was seen in *Germany*, *Poland*, *Switzerland*, *France*, and *England*, yet at *Upsal* they could observe nothing but the whole Sky beset thick with Clouds, of a Colour like that of the Moon in a total Eclipse, and variously agitated as by a Wind, but this chiefly towards the South; which continued till nine o'Clock at Night, a little after which it grew quite cloudy.



XXXI. *Jan.* 4. A Luminous Arch which extended itself from N. E. to West. The Streams all moved Westward. Wind N. W. *Merc.* 29  $\frac{1}{2}$ .

*An Account  
of the Lumen  
Boreale, as  
seen at several  
Times, by the  
Rev. Dr  
Langwith,  
No. 399. p.  
301.*

*Jan.* 5. We had something of the same Nature, but hardly enough for Observation; and yet, this very Night the Appearances were more remarkable in some parts of the Kingdom than those of *October* the eighth. This I was informed of by a Person of Quality in *Lancashire*, who was pleased also to send me the annexed Description and Draught, communicated to him by a curious Observer at *Liverpool*.

*March* 2d. Between 7 and 8, there was an Arch upon a black Basis as before, extending itself from N. E. to W. Its height variable, pyramidal Streams of Greenish Light moving westward. About a quarter past 8, there shot up from the West a Stream of pale Flame-colour about 6 or 7 Degrees broad: It passed over the *Pleiades*, and crossing the Meridian about 19 Degrees to the North of our Zenith, descended as low as the Tail of *Ursa Major* which it left a little to the South. It continued thus for some Minutes and then gradually vanished. Wind North, *Merc.* about 30.

*March* 3d. The Appearances this Night were so extraordinary, that they would require a long description: But I shall chiefly take Notice of such particulars as differed from those of *October* 8.

1. That instead of one luminous Arch in the North, here were two and sometimes three one above another. They were distinct enough from each other in their upper parts, but blended together towards the Horizon, which they generally cut about N. E. and N. W. but sometimes varied considerably from these Points.

The same Observation may be applied to the Heights, for they were also variable; and in particular, the inner edge of the lowermost Arch was at sometimes about 6 Degrees above the Horizon, at others, considerably more or less.

I suppose this extraordinary Appearance was owing to several distinct Collections of luminous Vapours, which were either at different Heights from the Earth, or different Distances from the Eye.

2dly, Several of the more permanent Streams were bent, at times, into irregular Arches of different Curvatures and Positions.

Some of them held pretty near the same shape till they vanished, others went off most commonly in *Tangents* to some part of the former Curves.

3dly, The flashing Streams from the East sometimes met with those from the West, and so formed continued Arches, of a pale Colour, which quickly broke and vanished. No colouring followed upon the mixture of these Streams.

4thly, The Streams of this kind moved mostly Southward, but not to any certain Point; for they were inclined to the Horizon at all Degrees between 5, or less, and 90. There was sometimes such a strange irregularity in their Motions as can hardly be described;



for the Places from whence the Flashings were directed seemed to vary every Moment.

As to the more steady pyramidal Streams, they generally moved Westward; and tho' some of them, at times, seemed to stand still, or even move backward; yet I am apt to believe, this irregularity was only apparent:

5thly, A little after the beginning of this *Meteor* there was a faint ruddiness in the Sky towards N. E. and N. W. but when it was in it's greatest perfection, towards 12 o'Clock, I saw none of the Prismatic Colours, tho' the Air was then full as Light as I have ever known it upon these Occasions. This helps to confirm me in the Opinion that the Prismatic Colours in these Meteors were owing to the Sun.

These Appearances began early in the Evening, and held, as I am informed, for a good part of the Night. Wind N. Westerly, Merc. above 30.

I am told that these Meteors are much more common in the North of *England* than here, and that they go by the Name of *Streamers*, *Merry Dancers*, or *Petty Dancers*. They also pretend to foretel the Weather by them, and say, that when the Streamers are green, they betoken wet stormy Weather; but when they are yellow, it will be clear and dry.

P. S. I don't know whether it is worth while to acquaint you, that *Aristotle* has given an imperfect Account of some of these Meteors.

*The Description of an Aurora Borealis mentioned in the foregoing Letter. No. 399. pag. 304.*

XXXII. About Seven o'Clock at Night I was told that the Meteor called by our Sailors, *Merry Dancers*, was visible, and very bright. Having seen several before, but had no opportunity of being particular in my Observation, I went out into the open Air, clear of Houses, that I might have a better View all round the Horizon; from whose Northern part arose several Streams of Light, as if from behind a black Cloud. They were very many, and I believe, there was no possibility of numbering them, their Motion being so quick, shooting upwards to the Zenith with a Motion not to be followed by the Eye. They had also another Motion which seemed to be side-ways, their higher Ends terminating sometimes in a sharp Point, sometimes in two or three Points; they appeared from the North-West to North-East; but were brightest in the North. Their Colour was pale like that of *Jupiter* through a Telescope, but not near so bright. Most of them reached the Zenith, where mixing with one another, they whisked round and formed an Appearance like the curling Flame of a Glass-House-Fire; they had a very irregular Motion, sometimes turning inwards, sometimes outwards, like the *Pendulum-Spring* of a Watch. This circular Light was the brightest, and seemed to occupy near ten Degrees of the highest part of the Hemisphere; Several Strokes of Light seemed to dart from it to the South; but died before they got any considerable distance. In the West, I saw two small



small long Clouds, which interposed betwixt me and the light Streams; which I saw above the Clouds, and betwixt them, which convinced me that this Light (whatever it be) is far above them. I have drawn a Scheme of the whole Horizon, as it appeared to me. That bright Star is *Jupiter*, whose Place then was  $17^{\circ}$  in *Aries*, and was about South-West, I guess about  $20^{\circ}$  high. Some of the brightest Stars in *Taurus*, *Orion*, and *Aries*, appeared South and South-East; but I have not placed those but by guess. In this state I left it: But was told by one that saw it after Ten o'Clock, that the whirling Light in the Zenith appeared of several Colours, as, blue, green, yellow, and red-dish. But that I did not see.

Fig. 16.

XXXIII. Die Martis, *Feb.* 19,  $17^{\frac{2}{3}}$ , hora fefquidecima.

Die Veneris, *Martii* 15,  $17^{\frac{2}{3}}$ , ab hora octava, ad mediam ufque noctem.

*A Register of  
Observations  
of the Aurora  
Borealis for  
four Years, at  
Lynn, by Mr  
W. Rastrick,  
No. 398. p.  
255.*

Die Martis, *Aug.* 20, 1723.

Die Dominica, *Oct.* 20, 1723, ab hora sexta, ad mediam noctem.

Die Dominica, *Sept.* 26, 1725, Aurora Borealis vifa eft ab hora feptima, ad horam decimam, cum Radiationibus variis.

Die Lunæ, *Oct.* 3, 1726, per totam noctem.

Item Die Martis, *Oct.* 4, 1726.

Itemque Die Saturni, *Oct.* 8, 1726, per totam noctem. Mirum fanè Phænomenon, de quo nihil dixi, qui tam accuratè describitur à Dominis Langwith, Huxham, Hallet, Hadley, & Johan. Ludov. Calandrino, in *Actis Londinensibus*, N<sup>o</sup>. 395.

Die Mercurii, *Oct.* 26, 1726, circa horam decimam.

Die Veneris, *Martii* 3,  $17^{\frac{2}{3}}$ , ab hora octava, ad mediam noctem. Aurora hac nocte (ut mihi videbatur) longe mirabilior fuit illâ *Oct.* 8; & credo equidem, nullatenus discrepavit (fecundum descriptiones quas habemus) ab illo memorabili Phænomeno, sexto *Martii*,  $17^{\frac{2}{3}}$ .

Item Die Domin. *Martii* 5,  $17^{\frac{2}{3}}$ .

XXXIV. About 8 in the Evening of that Day, my Family and others at *Windsor*, saw a considerable Streaming in the North, with fuch bright Lances and Columns as usual. But at *Redbridge* none fuch appeared, only in the North, I observed a great thick, black Bank of Vapours; the Top reaching about  $20^{\circ}$  above the Horizon, without any Convexity or Curvature, as is usual in most of the Streamings I have feen; but inftead of that, the upper Part was indented in many Parts, with long black Pyramids, fomewhat refembling the Streams of the *Lumen Boreale*, the Edges of which were gilded with lucid Rays, of the Streaming Colour: And all over the Clouds, or Vaporious Bank, I difcovered a great Commotion or Difurbance behind them, as if fomething was rolling, or tumbling behind them. The End of all thefe Appearances I expected would have been Streaming: But in lefs than an Hour, the Clouds (which had been pretty ftill) began to move to the S. W. and at laft obfcured the whole Hemisphere; which before was all clear enough (except towards the

*An Aurora  
Borealis Oct.  
13, 1728, at  
Redbridge  
near South-  
ampton, by  
the Rev. Mr  
Derham,  
F. R. S. No.  
410. p. 137.*



North ) to shew the Stars, although bespread with Vapours, like a thin Fog, a little inclining to red.

—Feb. 15.  
1730. N. S.  
at Geneva, by  
Mr Cramer.  
No. 413. p.  
279.

XXXV. The *Aurora* it self had nothing extraordinary; it was a quiet one, that is, without any sensible Motion, except, perhaps, an alternative Increase and Diminution of apparent Altitude. Whether it was for this Reason, or because the Light had it's Edge imperceptibly confounded with the Colour of Heaven, several People judged of that Altitude severally. There are some that pretend to have seen it to the very Zenith: I was not so happy, and could not see it higher than the Girdle ( $\beta$ ) of *Cephus*, which was about 30 Deg. high. The greatest Part did fix it to the Polar Star, which is about 46 Deg. It's Base reached from the Head of *Andromeda* and further, to the Shoulder ( $\gamma$ ) of *Bootes*, and further, and so it did insift upon an Arch of 140 or 150 Deg. of the Horizon. This Measure was taken half an Hour after Eight. It's Middle declined from North to West about 15 Deg. The Light was still, and clear enough to read a Character no bigger than that of this Letter. The Base has seemed obscure to some People.

But what was chiefly to be considered, was a great Meridional Zone pretty like a Rainbow in it's Figure, but broader. It was terminated by two parallel Arches. The superior insifted with one Side upon the true Point of East, and with the other upon the Point of South-west, or West-south-west: Whence you see it's Middle declined about 15 Deg. from South to East, and was diametrically opposed to the Middle of the *Aurora Borealis*. It's Altitude did vary a little, but never reached higher than the Head of *Orion*, which was 54 Deg. high, and never was seen lower than a little under *Procyon*, which is an Altitude of 45 or 46 Deg. The inferior Arch was exactly parallel to the superior, and the Breadth of the Zone varied from 14 or 15 Deg. to 18 or 20 Deg.

The Colour of this Zone was Red, Scarlet, inclined to Purple, pretty lively and changeable by Intervals. It was less vivid near the Horizon, and also to the Meridian, where it seemed now and then interrupted. Some Standers by did imagine two great Arches rising, one from the East, the other from the South-East, and meeting together near the Meridian, but immediately afterwards parting one with another, and drawing back, which they repeated very often.

Under this Zone then was to be seen, but not constantly, one or two Arches lucid and interrupted, which comprehend with the Horizon a dark Segment very like a Mist.

The Phænomenon did last till Four o'Clock in the Morning. The Weather was calm, serene, and cold, the Barometer very high; no Cloud in the Heaven.

It was remarkable, and I think extraordinary, that this *Aurora* considerably darkened the Light of those Stars which were seen through it; and that was much more true of the red meridional Zone, which dyed



dyed with it's reddish Colour the Stars that appeared behind. When that Zone was the highest, it covered *Jupiter*, and some Gentlemen, which at that Time had not yet remarked the *Aurora*, looking at *Jupiter* through a Telescope, affirm they could hardly see it, but that it seemed as intercepted by some dark Cloud; and indeed it looked at that Time as if it had been seen through a red Glafs.

This Observation confirms what is moreover very probable, that this Zone was produced by the Light of the opposite *Aurora*, either by Reflexion or Refraction. But the Manner of it's Production seems difficult to be accounted for. There may be supposed Icy Particles swimming in the Air, and of such Figure as to exhibit a great Zone, by the Reflexion and Refraction of the Light of the *Aurora*, almost in the same Manner as the Drops of Rain produce the Appearance of the Rainbow. But this being meer Conjecture, I shall pass it over.

The *Aurora* and Zone seemed a great deal nearer one another in the Horizon than in the Top. If we could suppose this Difference to be entirely Optic, and these two Circles really Parallels, that would be enough to compute the Distance of the Phænomenon from the Earth. But the Supposition, though it seemed, at first, pretty allowable, is by no means to be admitted; for it would follow, that the Phænomenon was at least distant from us one twenty-fourth Part of the Diameter of the Earth, which is too great an Altitude to be believed.

XXXVI. 1. The *Aurora Borealis* has been very frequent with us of late; but none either for Brightness, Variety, or Duration, so considerable as what occurred on the last *Thursday* Night, which was the 22d of *October*. This Meteor has been observed in *New-England*, at different Times, ever since it's first Plantation; but I think at much longer Intervals than of late Years, and never to so great a Degree as the present Instance: Nor indeed is there any recorded in the *Philos. Transact.* that I could think, by their Description, equal to it; excepting only that celebrated one of the 6th of *March*, 1716, observed by the most judicious and learned Dr *Halley*, and in many Respects that also must give the Preference to it. And on this Account I have thought the most particular Description of this Meteor would not be unacceptable to you; and have therefore sent all my Notes relating thereunto, which are very numerous, almost to every Change and Circumstance of the Appearance. I am perswaded there is no better Way to arrive at the true Cause of this extraordinary Phænomenon, than by attending to the minutest Particulars and Circumstances thereof; and if what I have done contributes thereunto, I shall esteem it a sufficient Excuse for the Number and Particularity of my Notes.

*Oct.* 22, 1730, 6<sup>h</sup> 30' P. M. There lay near the Horizon an extended dusky Vapour reaching from N W by N. to NE by E. The upper Edge was the Segment of a Circle, whose greatest Height

—*Oct.* 22,  
1730. in  
New-En-  
gland, by Mr  
Isaac Green-  
wood, Prof.  
Math. No.  
418. pag. 55.

*Obj.* I. *Fig.* 17.



from the Horizon was about  $15^{\circ}$  bearing nearly N. by E. Adjoining to this was a concentric Segment of a very light Azure, of a greenish Cast, strongly illuminated, a few Degrees in Breadth, and then dilated more and more till it became blended with an extensive Brightness, or *Aurora*, which lay every where above it for about 45 Degrees. There was in several Places a faint Cast of Red. The Heavens were every where else perfectly serene; a small Westerly Wind, and the Moon above  $80^{\circ}$  below the Eastern Horizon.

Obs. II. 6h.  
35'.

Two Striæ rising perpendicularly from different Parts of the illuminated Edge of the Vapour (which I all along suppose to continue it's Figure, when there is no particular Note to the contrary). These were of a faint Red, and to the Height of  $45^{\circ}$  at least.

Obs. III. 6h.  
40'.

The Striæ were very numerous to the Left, each about  $45^{\circ}$ ; and one in the Middle (by which I shall always mean the Middle of the Northern dusky Vapour) rose to a surprising Height. It was  $8^{\circ}$  or  $10^{\circ}$  in Breadth; of a light Azure tinged with Green, and in several Places streaked vertically with a bright Flame-Colour. There was also N W by N. a large Area or Body of a very intense Red.

Obs. IV. 6h.  
45' Fig. 18.

The whole extraordinarily luminous. The Red diffused in all Parts above the greenish Light, which now bounded the dusky Vapour in the North; and indeed several Parts of this were tinged therewith also. But the most intense Red was towards the N W. and N E. by E, between which were various pyramidical Streams of different Colours, some Blue, some Green, others Flame-coloured, &c. many tinged with, and all terminated by, the diffusive Rosiness. One Stria was of a surprising Lustre, of a light Azure turned upon Green, appearing N W. by N. This Scene was very beautiful, the Height of each Column about  $45^{\circ}$ , and many of them well defined.

Obs. V. 6h.  
50'.

The enlightened Part of the Hemisphere was every where tinged with Red; it's horizontal Bounds the same as before, but it's Altitude about  $70^{\circ}$ . Whence it appears the *Aurora* is considerably extended upwards. The reddish Cast on the right Hand from North to East was beautifully distinguished into perpendicular Striæ, which generally observed the following Order of Colours, beginning from the East; viz. a deep Azure, which successively proceeded to the lightest Blues (though each Column was of such Intensity as to be distinguished from the neighbouring Columns) after which followed several Degrees of Green, and then of Red, the deepest being an intense Scarlet. And this Order was repeated several times, filling up the whole Space from N E. to N by W. The Western Regions were at the same Time of an undistinguished Red. Many of the rising Columns were very exactly terminated.

Obs. VI. 6h.  
55' Fig. 19.

The Red, which in the last lay towards the Zenith, became very intense; darting to the horizontal Vapour, throughout the intermediate Space, innumerable Striæ differently coloured. The horizontal dusky Cloud was somewhat raised; an apparent Stratum of Blue



just under it, which towards the Horizon was of a fainter Cast, as the Colour of the Sky is when over-charged with Vapours. I should not forget that the upper Surface of Red jutted out, irregularly, in several Places, though in general well terminated; as I have observed the Case has been in some rising Clouds.

The distinguished Red towards the Zenith, approaching nearer thereunto; it is about  $20^{\circ}$  broad upon our Meridian, and thence tapering to the Eastern and Western Horizon. The whole Appearance is of a reddish Hue, 'tis in some Places faintly streaked. At this Juncture appeared ESE considerably removed from the other Phænomena, a remarkable Oval, the transverse Diameter erect, about  $30^{\circ}$  in Length, and of a very bright Azure. The whole Scene was very beautiful. *Obs. VII. 7<sup>h</sup>. 0<sup>'</sup>.*

The Phænomena much the same, excepting that the reddish Cast has risen, and is now diffused to the Southward of the Zenith. The other Parts of the Northern Hemisphere much like the genuine *Aurora*, interspersed with various small Clouds. There are two distinguished parallelogramic Areas of an intense Red, nearly  $30^{\circ}$  in Diameter, the one to E by N. the other to NW. which was of the deepest Colour, and crossed in the Middle with a black Bar. The bright azure Oval still remains towards the ESE. *Obs. VIII. 7<sup>h</sup>. 2<sup>'</sup>  $\frac{1}{2}$ . Fig. 20.*

The whole Appearance seemingly vanished, excepting that the Northern Regions retained the *Aurora*, which was as bright as about half an Hour after Sun-set. The Eastern Area of Red was distinguishable, though very faint, reaching from  $30^{\circ}$  to  $50^{\circ}$  high; also the former Area to the NW. somewhat more intense. This was the same as in the last Article; and the black Bar mentioned then, appeared now to be a Cloud moving Eastward, Part whereof was seen on this red Area, and Part to the North. And in this View the red Vapour appeared vastly more distant than the Cloud. There were several small Spaces of Light interspersed throughout the Scene. *Obs. IX. 7<sup>h</sup>. 5<sup>'</sup>.*

The Appearance somewhat changed. The Area of Red NW. was the most intense. Several rising Columns of a faint red and blue between West and North. A deep Red E by N. I have all along observed, that some of the fixed Stars could be seen through all the Colours that have successively laid upon them, though with considerable Differences as to Obscurity and Clearness, according to the Intensities of the Colours. No Clouds in the Southern Regions. *Obs. X. 7<sup>h</sup>. 15<sup>'</sup>.*

It is now necessary for me to observe, that the Wind has been all along West and W by N. and if the strongest Winds be expressed by 10, this was sometimes 2, and, I think, never less than Unity. I am informed that at *Boston*, which lies about three Miles Eastward, it was all the while to the Eastward of the South. The *Aurora* still of the same Dimensions, but the Edge of the dusky horizontal Cloud much abated of it's Brightness and Colour. There are four remarkable Spots, or Areas of Red, one E by N. one NE. by N. very intense, *Obs. XI. 7<sup>h</sup>. 20<sup>'</sup>.*



intense, as also was another nearly North; and the last bore N W by N, which, with the E by N, has been of some considerable Duration.

There were several considerable Striæ intermixed with red, and a Flame-colour rising about N N W.

Obs. XII. 7<sup>h</sup>. 28'. The Redness about the North increased in it's Dimensions and Intensity very much. It reaches from the North Star to about 20° upwards, and for about 12° is exceedingly bright.

It is distinguished into several perpendicular Columns of various Degrees of Red, and many well terminated.

Obs. XIII. 7<sup>h</sup>. 30'. The Redness N E by N. moves Westward, and is considerably altered in that respect since the first Observation thereof. That about the North Star is now divided in the Middle by a perpendicular Column, very broad, and of a very intense yellow Light. It appears now that this also has a slow Motion Westward: But the Western Redness has all along advanced Eastward at a considerable Rate.

Obs. XIV. 7<sup>h</sup>. 37'. Fig. 21. The three red Areae just mentioned are now united, and nearly confounded with one another. The Distinction is only as to the Degree of Redness. The *Aurora* which lies partly under these is considerably abated of it's Lustre; and the horizontal Bounds contracted to about 80°, though the Altitude is rather increased. The Eastern and Western Limits seem still to approach one another very slowly. There was one Stria very considerable, horizontally posited, and about 5° broad, of a bright Flame-colour, reaching from the horizontal Bounds throughout the whole Meteor Arch-wise, whose greatest Height was about 15°.

Obs. XV. 7<sup>h</sup>. 45'. The Flame-coloured Arch much diminished. The Redness very evident, and contiguous; though in some Places of different Intensities, and visibly increasing about N by W. On each side of which there was a distinguished Ruddiness.

Obs. XVI. 7<sup>h</sup>. 51'. The Distinction of Redness about N by W. changed to a more intense uniform Redness, which seemed to be by the Union of the aforesaid distinguished Areae; and the greatest Intensity was in the middle Space that was between them; viz. N by W. At this Juncture I was not a little surprized with an extraordinary Flash of Lightning very bright, which began about the midst of this congregated Vapour, and ran with an oblique undulatory Motion for 20° towards the Horizon.

Obs. XVII. 8<sup>h</sup>. 1'. The Redness still continues, but much abated.

Obs. XVIII. 8<sup>h</sup>. 9'. The Meteor scarce to be distinguished but by the *Aurora*, which reaches from N W to E, in such Sort of Curve that the highest Part is due North about 40° of Altitude. There is still a reddish Cast N N W.

Obs. XIX. 8<sup>h</sup>. 30'. The Colours not very considerable; but the Form entirely new. The Breadth of the Redness was from the Pole Star downwards about 20°; and from thence it run tapering on the left Hand to W by N.

and



and on the Right to the East. In which Points it was of no discernable Breadth. Its upper Edge was of the deepest Red, which dilated by Degrees to a Flame-colour, and could scarce be distinguished from the neighbouring *Aurora*. However, there were two Spots, one to the Right, and the other to the Left, in the extensive Arch of a remarkable Sadness.

This was an extraordinary beautiful Appearance. From the Zenith about  $20^{\circ}$  Southward, an uncommon Redness was formed, as it were into a Knot or Canopy, very distinctly terminated (especially on the South Parts) about  $20^{\circ}$  in Length, which lay East and West, and little less in its Dimensions North and South. From this issued innumerable Striæ throughout the Northern Hemisphere and farther, the horizontal Bounds being WSW. to ESE. These Striæ were dispersed in an exact Order, proceeding from the aforesaid Knot, as Folds equally diverging, and each of the same Colour and Brightness throughout the whole Space to the Horizon. The Order of the Colours was very agreeable, interchangeably blue, red, and then Flame-colour; each of which was also distinguished into Striæ of various Intensities, from the deepest blue to the lightest; from the Bounds of Violet, to a Tincture of Orange; and lastly, from the Colour of the *Aurora* to the brightest Flames. And this Order was repeated innumerable Times throughout the whole Scene. The whole was as bright, and in many Respects resembled a Series of Rainbows vertically posited; and in this View the Generality of People will always remember it. And indeed were the Heavens to be disposed into innumerable Rainbows (excepting only the greater Number of Primitive Colours) it would scarce exceed this Phænomenon in Beauty: And the Knot from whence it seemed to proceed, far surpasses any of the Redness of that Meteor, and even Blood itself. It may not be amiss to observe here, that the Western Breeze has been for some time since perfectly lulled; nor is there the least Motion in any Part of the Heavens.

The Northern Bank of Vapours has all along continued, and now reaches from W to E by S, its greatest Height about  $8^{\circ}$ .

The bloody Knot wholly vanished; though several of the descending Striæ remain entire, and in many Places Parts of others, all of the same Direction, and a fainter Colour than before. The Sky is perfectly calm and serene.

The Northern Regions retain a bright *Aurora*, interspersed with a reddish Cast. From the Zenith is diffused a very extensive red Vapour, reaching to the Southward near  $30^{\circ}$  from the Zenith, and from thence converging towards the Eastern and Western Horizon, where it meets, the one E by S, and the other WSW. The Southern Edge was of the deepest Red, and the most distinguished Redness WSW. There appeared a falling Star SW. of a considerable Duration.



Obs. XXIII.  
10<sup>h</sup>. 2'.

The Meteor much advanced to the Southward, it's greatest Height being not above  $40^{\circ}$  from the Horizon: It's horizontal Bounds E S E and W by S. It's Redness much abated; but the *Aurora* diffused every where throughout the Scene, as conspicuous to the South as towards the North Parts of the Zenith; which was an uncommon Sight. The Sky was now remarkably hazy, and full of Vapours.

Obs. XXIV.  
10<sup>h</sup>. 18'.

The *Aurora* advanced considerably to the Southward of the red Vapour, which now is much diluted, about  $20^{\circ}$  in Breadth, a Part of it at least  $50^{\circ}$  to the Southward of the Zenith, and tapering towards the Eastern and Western Horizon, where the Bounds are much the same as before.

Obs. XXV.  
10<sup>h</sup>. 25'.

Fig. 23. in  
which Z de-  
notes the Ze-  
nith, and  
N. E. S. W.  
the Horizon.

The *Aurora* separated from the reddish Vapour considerably, in the upper Parts, though joined in the horizontal, and not above  $25^{\circ}$  from the South Horizon. Not any distinguishable red to the Northward, but an Arch of the *Aurora* of much the same Height, though much inferior in it's horizontal Measure. The Southern and Northern *Aurora* each very bright. There were several temporary Flashes in many Parts of the red Vapour. At this Juncture the *Aurora* seemed to appertain as much to the Southern as Northern Horizon; and the Redness considerably more: But there was a great Difference just towards the Horizons; the one being covered with the dusky Vapour so often mentioned, and the other appearing of it's natural blue.

Obs. XXVI.  
10<sup>h</sup>. 35'.

The Appearance over, excepting a reddish Cast to the Eastward, and a faint *Aurora* in the Northern Regions, of but small Extent from the dusky horizontal Vapour.

Obs. XXVII.  
11<sup>h</sup>. 35'.

There have not been any remarkable Phænomena since the last. The Northern *Aurora*, with the dusky Vapour, still continue, and I think as evident as at any of the foregoing Periods.

Here I ended my Observations. I am informed by others, who were occasionally on the Water, that it's beginning was just after Sun-set, in the Form of an extended darkish Cloud rising Northward; a few Minutes after the Appearance of which, there was, towards the Eastern and Western Regions, a very distinguishable Tincture of red. And the next Change was my first Observation.

Obs. XXVIII.  
11<sup>h</sup>. 45'. Fig.  
24.

It appeared in a new and very surprizing Form. The Edge of the horizontal Vapour was strongly illuminated, as though it had been fired; and this was in Height about  $8^{\circ}$ . From hence arose up continually, following one another, very extensive horizontal Columns of a bright Flame-colour, which in scarce a second of Time reached some to  $40^{\circ}$ , others above  $60^{\circ}$  of Altitude, and many to the intermediate Altitudes. Each of these Columns were as though a horizontal Train of Gunpowder had been suddenly fired, and the Flashes regularly propagated to such enormous Heights in a horizontal Posture. And there were innumerable Successions of these rising Flashes, the Phænomenon continuing nearly a quarter of an Hour. This Comparison will also illustrate several other Particulars



at this Juncture. Sometimes there were several of these Flashes ascending together, at a little Distance from one another, as though there had been several horizontal Trains successively and almost instantaneously kindled after one another. Sometimes the rising Line of Light would be continued horizontally throughout the whole Scene, in other Places three quarters, an half, one third, a quarter, &c. of the same Length, as though these Trains had been unequally extended. Sometimes the Flash would begin in the Middle, and run kindling to the Extrems: Then, at one Extream, moving towards the other; and at other Times in more Places than one: But in all these Varieties, the horizontal Motions ceased, and the whole became one uniform Line before it had passed the enkindled Edge of the Cloud, which was not above  $8^{\circ}$ , as I observed before. All which may be well represented by the aforesaid Trains of inflammable Matter, sometimes enkindled in one Place, sometimes in another, but always propagated through the whole Train, with so swift a Motion, that there could be no considerable Difference as to the Height of one Part above another. The greatest Extent of these horizontal Flashes was from NW to NE. After these Phænomena the Meteor assumed it's usual Form; viz. a bright *Aurora* settled upon a dusky horizontal Vapour.

The Meteor was again formed into much the same Shape as was *Obs. XXIX.* described in Observation the twentieth, but of fainter Colours considerably. It vanished also again in the same manner.

The *Aurora* continued till Day-light; and the Phænomena, at different Times, and without any certain Periods, were much the same as I have described in one or another of the foregoing Articles. *Obs. XXX, 6h. 30'.*

I shall conclude these Notes, by observing, that the Day before this Meteor was very warm for the Season, though early in the Morning there was a very considerable Hoar-Frost. The Morning following was remarkable for an abundant Dew. The Temper of the Air much the same as the preceding Day. About Eight o'Clock the Heavens fair and calm. Barom. 30.1. Therm.  $\frac{38}{100}$ .

You may observe, that in the Figures I have attempted the *Stereographic Projection* of the most considerable Scenes, which may be a considerable Assistance to the Imagination; though I think the Expressions do not absolutely require any Schemes.

I have compared these Observations with what I could find relating to the *Aurora Borealis* in the *Philos. Transact.* &c. and think there are few Particulars mentioned there, but what occurred in this wonderful Instance; some that are rare confirmed, and a few altogether new; but the chief Advantage, I suppose, in these Notes, in the Process, Crisis, and Decay, which is so obvious in many of the most remarkable Scenes.



—by Mr  
Rich. Lewis;  
No. 418. pag.  
69.

2. About Six at Night the North Part of the Hemisphere appeared of a faint red, the Horizon was very dusky, and this Redness was bounded above by a very dark Cloud.

As the Night advanced this Meteor reddened, till it was of as deep a Colour as Blood; and it spread itself to the North East. It continued all Night, but about Two in the Morning, I observed that it sent forth two and three Streams from it's North Part, of a whitish Colour, which shot up to the Zenith. These Emanations looked much like the Rays of the Sun, when they pass through a dark Cloud, when it's said to be drawing Water. I took it to be an *Aurora Borealis*, but it appeared much fainter than those I have seen in *England*.

Dr *Samuel Chew* at *Maidstone*, tells me, that he has for some Days past, at Morning and Evening, observed several Spots in the Sun, very plainly with his naked Eye, some of which seemed very large.

An Invitation  
to an Association  
in forming Meteorolo-  
gical Diaries,  
by James Ju-  
rin, M. D.  
R. S. Sec.  
No. 379. p.  
422.

XXXVII. *Cœli & Aëris, quem spiritu ducimus, conditiones varias, frigoris, putæ, & caloris, sudi, vel humidi commutationes & vicissitudines, magnas præsertim atque subitaneas, ad Humani Generis valetudinem pertinere merito censetur. Operam itaque & laborem in iisdem observandis minime contemnendum posuerunt non Medici solum, sed & alii quoque ab omni ævo Naturæ rerum contemplandæ studiosi. Superiore tandem sæculo Instrumenta etiam & Machinæ Philosophorum ingenio & diligentia repertæ sunt, quibus ponderis, caloris, humiditatis, & elateris aërii momenta & mutationes simul oculis repræsentantur, simul ad mensuram ac trutinam, & quidem subtilem admodum illam atque accuratam, exiguntur.*

*Nec hic etiam subsistendum judicarunt Eximii illi Viri, sed studio & sciendi amore incitati ad causas harum mutationum, quâ licuit, indagandas contenderunt. Quem in finem Observationes Instrumentorum recens inventorum ope factas de pondere, humiditate, & calore ambientis diligenter in Diariis notabant; iisque multa alia adjiciebant ad Tempestatem ac Cœli faciem, Ventos, & Pluviæ copiam pertinentia, quod in Actis Philosophicis & alibi sparsim videre est.*

*Methodo istâ & observandi ratione meliorem facile non reperias. Quod si fuissent Observatores & numero idoneo, & commodis locis per magna terrarum spatia dispositi; ac tandem unus aliquis omnium Diaria, quid inter se convenirent aut discreparent, contulisset; profecto jam a multis annis eam haberemus Aëris Historiam, qualem hoc temporis vix animo & votis fas est concipere.*

*Id etenim compertum habemus, ut quod maxime, subitas Tempestatum commutationes Ventis præcipue acceptas esse referendas; quumque scire liceret per talem observandi rationem, qualem supra exposuimus, quibus in locis orti, quem cursum, quo tempore & per quanta terrarum spatia Venti tenerent; his cognitis, forsan ad Originem etiam & Causas Ventorum assequendas via patuisset. Unum hoc saltem, quod ipsum non leve momentum ad has disquisitiones attulisset,*



tulisset, quodque jam, ut plurimum, pro Conjecturâ verisimili haberetur, potuissimus certissimis observationibus sive veri, sive falsi arguere. Opinionem dico sagacissimi Viri, *Edmondi Halleii* \*, qui Hydrargyrum ideo censet in Barometro ascendere, quod Venti ex contrariis regionibus utrinque eodem spirantes Aërem cogant & quasi in cumulum attollant; ut contra Hydrargyri descensum Ventis, ex eodem loco versus oppositas partes Aërem deferentibus, & quasi exhaurientibus, attribuit.

Rogantur itaque Eruditi, qui ad excolendam hanc partem Historiæ Naturalis operam suam conferre voluerint, ut quotidie semel minimum, vel utcunque sæpius libuerit, notare dignentur in Diario Barometri & Thermometri altitudinem, Venti Plagam cum aliquâ virium æstimatione, Cœli faciem, & Pluviæ vel Nivis quantitatem, quæ tempore post observationem superiorem elapso deciderit. Quod si quis Observationes Hygroscoopii cujuscunque, sive Acus Magneticæ ope factas adjicere voluerit, non erit ingratum.

Quoties ingruerit Procella vehementior, utile fuerit ortum ejusdem, incrementum, summam violentiam, remissionem & exitum notatis temporibus accuratius designare, uti & altitudines Barometri, quæ dictis temporibus respondeant.

Monendum censemus, ut qui Barometri replendi & conficiendi modum callent, Barometro vulgari, sive aperto, quod vocant, utantur. Sit autem Tubus quartam, ut minimum, vel etiam tertiam digiti partem latus, quum in Tubis angustioribus Hydrargyrum infra justam altitudinem subsidere deprehendatur †. Cisternæ vero, sive Vasi Hydrargyrum excipienti tribuetur diameter octonis saltem, vel decem partibus major Tubi diametro, idque eum in finem, ut ascendente, vel subsidente Hydrargyro in Tubo, altitudo Hydrargyri in Cisternâ invariata permaneat, aut certe quam paululum immutata.

Qui vero Barometro clauso, sive portatili uti malunt, ejusmodi Barometra magnâ diligentia fabricata comparare poterunt apud Laudatum Artificem *Franciscum Hawksbejum*, in Areâ vulgo dictâ *Crane-Court*, *Londini* degentem; qui Thermometra etiam subministrabit ad eam Scalam, sive graduum notationem exacta, quæ jam per multos annos, exquisitis ejus Thermometris insculpta, innotuit Eruditis.

Qui Thermometro utuntur aliâ quâcunque ratione constructo, rogatos volumus, ut in Diario Thermometri situm, fabricam, dispositionem graduum in Scalâ, & nomen etiam Opificis, ex cujus Officinâ prodijt, apponere ne graventur. Situm Thermometro commodissimum censemus in conclavi ad Septentriones obverso, ubi focus aut nunquam accenditur, aut saltem quam rarissime.

Quo facilius inter se conferri possint Diaria, commodum fuerit omnia in hujusmodi formam disponere.

Columna prima indicet diem & horam observationis; stylo autem ut omnes Juliano, sive Vetere, in Diariis utantur, Observatores rogamus.

\* *Vid. Philos. Transact. N. 181.*

† *Vid. Philos. Transact. N. 363*



Secunda altitudinem exhibeat, ad quam attollitur Hydrargyrus in Tubo Barometri supra superficiem Hydrargyri in Vase, per digitos, five partes duodecimas Pedis *Londinensis*, & per partes decimales eorundem digitorum notatam. Habet autem Pes *Londinensis* ad *Parisiensem* eam rationem, quæ est inter 15 & 16 proxime.

Columna tertia gradum monstret, & partes gradus decimales, quas Spiritus in Thermometro attingit.

Quarta Venti Plagam & spirandi vires repræsentet; quæ vires semper denotari poterunt per aliquem ex numeris sequentibus, 1, 2, 3, 4: ex quibus 1 significet lenissimum Aëris motum vix arborum folia agitantem, 4 vero summam Venti violentiam; numeris 2 & 3 intermedias inter hæc Ventorum vires exponentibus, & denotante cyphrâ, five 0, perfectam Malaciam.

Quintam occupet Cœli facies, & succincta Tempestatis historia.

Sexta & ultima altitudinem pluviae, vel nivis in aquam resolutæ, quæ post superiorem observationem deciderit, per digitos *Londinenses* & eorum partes decimales metiatur.

Hæc facile æstimari poterit ope Infundibuli duos circiter, vel tres pedes ampli, Vasis alterius aquam ex Infundibulo defluentem excipientis, & Mensuræ Cylindricæ cum Regulâ in digitos & partes decimales divisâ. Infundibulum ita situm sit, ut, quicumque ventus flaverit, nulla tamen pluviae pars sive ædificii interventu, five quocunque alio impedimento intercipi queat. Sit autem vas aquam continens undique probe clausum, ne quid in vapores attollatur, angusto solum foramine, ad aquam desuper ex Infundibulo excipiendam, relicto. Mensuræ porro Cylindricæ Diameter decem partibus minor Diametro Infundibuli tribuetur: quo fiet, ut aqua digitum unum alta in mensuræ ad altitudinem centesimæ partis digiti in Infundibulum, atque adeo in reliquam terram, cecidisse intelligatur; & similiter pro partibus digiti decimalibus.

Ad finem vero Mensis & Anni cujusque apponatur media altitudo menstrua, vel annua, Barometri & Thermometri, uti etiam summa omnium altitudinum Pluviae, quæ Mense, vel anno integro deciderit. Habebitur autem dicta media altitudo, redigendo in unam summam, omnes Barometri altitudinum observationes mane factas, Thermometri vero five matutinas, five totius diei maximas, (quæ nempe circa horam tertiam, vel quartam pomeridianam contingunt) & summam istam per numerum dierum dividendo.

Omnes rogamus, qui suprascriptas Observationes, vel universas, vel aliquâ ex parte volent instituire, ut Diariorum Exempla, ad finem anni cujusque continuata, ad Secretarios Regiæ Societatis transmittere dignentur; uti cum Diario, quod *Londini* jussu Societatis Regiæ conficitur, conferri possint. Consilium vero est, ut quicquid ex Diariorum istorum collatione colligi poterit, singulis annis in Actis Philosophicis cum Publico communiectur.



Diarii Forma.										
Dies & Hora. 1723.		Barom. alt.		Therm. alt.		Vent.		Tempestas.		Pluvia.
Nov. St. V.		dig. dec.		gr. dec.						dig. dec.
1. 8 a. m.		29.	75	49.	6	S. W.	1	Cœlum nubibus obduct.	}	0.035
4 p. m.		29.	56	47.	3	S. W.	2	Imbres interrupti. Sol pervices intercur- rens		0.043
2. 7 ½ a. m.		29.	24	48.	5	S.	1	Pluvia fere perpetua		0.725
3. 9 a. m.		29.	95	49.	7	N.	1	Cœlum sudum		0.032
5 p. m.		30.	4	49.	2	N.	1	Cœlum sudum		0.000
4. 7 a. m.		29.	9	47.	0	S. W.	1	Nubes sparsæ		0.000
10		29.	7	46.	2	S. W.	2	Imbres intercurrentes		0.103
12		29.	4	45.	0	S.	3	Cœlum nubibus un- dique fere tectum		0.050
3 p. m.		28.	8	46.	0	S.	4	Nubes sparsæ		0.000
5		28.	6	47.	2	S. W.	4	Eadem Cœli facies		0.000
7		28.	9	48.	0	S. W.	2	Pluit		0.000
9		28.	9	48.	2		0	Pluvia fere perpetua		0.305
5. 7 a. m.		29.	7	53.	4	N. E.	1	Sudum. Gelu.		0.250

XXXVIII. This Method in general is, that in Addition to such Observations as should be made on Land, there might be some Account taken of those also that were made at Sea; which already are by far more numerous than what were ever made ashore, or indeed what can be expected thence for some Ages still to come. This Method occurred to me, as I was looking over various *Journals of Voyages* in my Passage from *England*, in which I was not a little surprized to find the following Particulars constantly observed.

First, There was a general Account of the Weather for every Day, during the Passage of the Ship on the Voyage, which though not quite so exact as the Observations of the same Kind that have been made on Land, particularly what were published by the Rev. Mr *Derham*, yet for all that I know, are sufficient for the Design. However, if there is any Defect in this Article, it is abundantly made up in another Column; which is a far more exact Register of the Direction of the Winds than was ever kept ashore, being an Account thereof to every two Hours in the Day. This Article may perhaps be of very great Importance; since, as Dr *Jurin* observes, *Comper-tum habemus, ut quod maximè, subitas tempestatum commutationes Ventis præcipuè acceptas esse referendas.* As for the Degree or Strength of the Wind there are also sufficient Data in all Sea Journals to determine it, as I shall particularly shew in the Sequel of this Paper. Lastly, there is a daily Account inserted of the Latitude and Longitude of the Ship, that there will be no Difficulty in computing what Part of the Globe each Observation belongs to.

And now since there is in the World a great Variety of these Marine Observations already made, (for in all Voyages whatsoever that

*A new Method for composing a natural History of Meteors, by Mr Isaac Greenwood, Prof. Math. at Cambridge, New-England, No. 401. p. 392.*



have been performed for many Years past, it has been customary to keep an exact Journal of the aforesaid Articles,) I thought it might be no difficult Matter to collect therefrom the History of the Winds, and Weather in most Parts of the Ocean.

In order to this, I imagined that if the Royal Societies of *London* and *Paris* should encourage such a Design, they might easily procure Extracts from most of the Journals kept in their respective Nations: For certainly such Gentlemen as would be at the Pains to keep a constant Diary of the Weather, would not fail also to communicate such Marine Observations, as they should be able to obtain.

The Seamen likewise themselves, (among whom there are a considerable Number of such as have a Taste for Physical Knowledge) as they are under a Kind of Necessity to observe exactly the Winds, &c. would not be backward in transmitting their Observations; especially when they were informed of what Importance and Advantage it might be to themselves, and the Cause of Navigation.

I proceeded further to think, that if the aforesaid Societies should judge it improper to be at so great an Expence as would be requisite in printing so many Extracts from such Journals as should be sent to them, that they might notwithstanding keep in Manuscript a Book of Tables of such Marine Observations, as they should think fit to collect therefrom; and that the Secretaries of the Society (who for the most Part are such Gentlemen as have in a particular Manner discovered a generous Principle of promoting Natural Knowledge) should take Care, that all such Observations were transcribed in their proper Places.

The Form of these Tables I thought might be in the following Manner.

<i>January the First, 1726.</i>										
Longitude 20				21.				22.		
Latitude	H.	W.	D.	Weather.	W.	D.	Weather.	W.	D.	Weather.
	—	—	—	—	—	—	—	—	—	—
30.	12.	N.	2.	Fair.						
	6.									
	12.	N b E	3.	Fair.						
	6.									
31.	12.							S b E	2.	Cloudy.
	6.								2.	Rain.
	12.							S	3.	Storm of Rain.
	6.							S b E	2.	Rain.

In which the *Title* shews the *Year*, *Month*, and *Day*; the *horizontal Space* just below it, the *Longitudes*; the *vertical Space* without the double Lines,



Lines, the *Latitudes* ; that within the double Lines, the *Hour* of the Day ; and the *horizontal Spaces* under the Longitudes, the *Wind*, it's *Degree*, or *Strength*, and the *Weather*, which are accordingly marked with W. D. Weather.

In this Specimen I have noted every Degree of Latitude and Longitude, that the Work might be the more perfect. I have only taken Notice of Four Hours in the Day, viz. 12 at Noon, 6 in the Afternoon, 12 at Night, and 6 in the Morning. However, if there be required a greater Exactness in this Article, it will be easy enough to frame Tables accordingly. I began the Hours with 12 at Noon, because all Journals are kept from that Period, the Marine Day being always counted from Noon to Noon. There may be other Columns inserted, as I shall mention in the Close of this Paper, though what I have already taken Notice of is sufficient to our present Design.

Of these Sort of Tables there must be at least Four Volumes ; One for that Part of the Atlantic Ocean, which such Ships generally pass over, which Trade between *Great Britain* and the *West Indies* ; another for those Parts of the Ocean, that lie in the Passage of such Ships as are engaged in the Mediterranean, or *Turkey Trade* : to which may be added a Table for the *African*, and *India Commerce*. A third may be framed for that Part of the Ocean, that lies between the Northern Provinces in *America* and the *West Indies* ; and a fourth for the Ships that pass between *New-England*, and *New-York* and *Britain*, which on the Northern Part may be made so wide as to take in the *Newfoundland Trade*, &c.

It must be confessed, that the Work will be very much protracted, and require some considerable Application and Care, in extracting such Observations, as shall be of Use, from Journals. There will also be some Difficulty in procuring any considerable Number of such Journals ; and lastly, there is but a very small Number of Observations made in Comparison to the Spaces that must be allow'd in the Tables for them, by which Means there must necessarily be a great Waste.

In Answer to these Objections, it may be said in general, that there will be much less Application and Care required than in keeping a *Diary* of the Weather, &c. on the Land. By this Means also, there may be more Observations collected in a few Years, than can be expected from the other Method in some Ages ; and one Man may be able in a few Months, hereby to compile a larger History of the Weather, than what has hitherto been done by the united Observation of all such, as have undertaken this Province.

Though there might be some Difficulty as to particular Persons in procuring a great Number of Journals, it cannot be supposed, that so illustrious a Body of Men as the *Royal Societies* at *London*  
and



and *Paris*, should meet with the same. It is observable also, that in the *Royal Navy of Great Britain*, the Masters of the *Mathematics* are obliged to keep such a Journal by an Act in the late Reign, on Board every Ship, which without Doubt might be easily obtained on this Occasion: Nor can we imagine any in the trading Interest would refuse a Thing, that tended so much to their own Advantage and Benefit.

It is true, there can be no Remedy for the many empty Spaces in the Tables (if that Method be followed which I have proposed); however this will be look'd upon as a trifling Objection, by such as consult the Improvement of Natural Knowledge, rather than the Waste of Paper.

I shall conclude these general Remarks, by observing, that as the History of the Winds and Weather is capable of a more speedy and expeditious Improvement from Marine Observations than from Diaries from the Land, so also it is capable hereby of a more large and extensive Improvement. Without Doubt it will require many Years before Observatories of the Weather, &c. will be erected at all the *Universities* and *Capital Towns* of the Provinces, Shires, &c. in *Europe*, (if ever such should be) not to mention *Africa*, *Asia*, and *America*, from which little can be expected in this Affair; and yet upon that Supposition, how few would the Diaries be, in Comparison of the great Number of Journals that are annually kept at *Sea*? besides many Thousands that might perhaps be obtained, relating to the Course of the Winds and Weather, successively for many Years last past. It is beyond my Abilities, indeed, to calculate with any Exactness, how many Vessels there may be upon the Seas which I have named, in the Space of one Year, and consequently how many distinct Journals there are annually kept; however, if I may judge from the Trade of the little Town, where this Letter is dated, there must be many Thousands: For there are seldom less than eight or nine Hundred Voyages made to and from this Port in a Year. I shall only add in this Place, that the Method here proposed seems to have the Advantage of the common Method heretofore used in composing the Natural History of Meteors; inasmuch as that requires a particular Application and Attention without any other Views and Advantages; whereas in our Case there is a Kind of Necessity of making such Observations, in order to conduct a Ship safely thro' the Ocean, whether the Philosophical Part of Mankind shall think fit to improve them in their Interest, or no: However, I would not be understood, by any Thing that has been said upon this Head, to derogate from the Design of observing on Land, for that likewise has many Advantages, that we can by no Means pretend to in the New Method.



We may be able from this Method to define with a great deal of Exactness, the Bounds and Limits of all considerable Winds; for as there are at all Times in the Year some Hundreds of Vessels at Sea, it is of the same Importance in our Case, as though there were so many distant Observatories there; and that the Knowledge of these more extensive and general Winds would be of considerable Use, none will deny, that shall attentively consider it; for hereby we may be able to judge, in what Place such a Wind has it's Origin, how long a Time it continues, with what Velocity, it moves, where it's greatest Strength is, and how great a Part of the Earth it passes over. Perhaps also, in Process of Time by this Means, we may arrive to so much Skill, as to judge with some considerable Certainty, from the Rise or Beginning of a Wind, what it's Effect and Issue shall be; which will be of as great Importance in Navigation, as any Thing still wanting. Again, from such Marine Observations of the more extensive and lasting Winds, it is not impossible, that we should be able to make a probable Judgment of the Effect and Influence of the Wind upon the Weather; which, for what Cause I know not, I have frequently observed at Sea, to change and alter, according as that doth.

From collecting all such Meteorological Observations as are made at *Sea*, we may reasonably expect to come to the Knowledge of such Winds, as prevail most in particular Latitudes. Though the Wind is a very uncertain Meteor, there is no Doubt, but that in some Places, it has a very different Course from what it has in others. If I mistake not also, it has been frequently observed, in some particular Places, that the Course of the Wind in one Year has been much the same as in others; and though there has been no particular Order or Exactness yet discovered, yet the prevalent Winds, or the greater Number of Winds have been in both Cases, according to the same Direction: In these Parts of the World it is remarkably so. We cannot, indeed, expect to discover the Reigning or Prevalent Winds of such Latitudes, as are very distant from the Tropics, by as easy an Observation, as the Trade-Winds and *Monsoons*, which are in the *Torrid Zone*, were first found out. However as it has been after many Observations, that the Course of those Fixed Winds was determined, we may also hope, that Time and Industry may bring us to a much better Knowledge than what we have at present, of these which are more Variable. I need not say of how much Importance it would be to the Trading Part of the World, were we able to define the more frequent and reigning Winds of every Climate; for as the Probability of Voyages might then be calculated in the same Manner as that of other Chances, the Sailor might then better know



how to order his Course so, as to arrive with the most probable Dispatch to his Port.

It may not be impossible also, from a protracted Series of Sea-Observations, not only to know the general Course of the Winds in every Climate in the whole Year, but also to make a very probable Judgment of the reigning Winds of the several Seasons of the Year, and perhaps of every Month too: Which if it could once be obtained, we should have nothing more uncertain in Navigation, than that it was a Doctrine of Chances, which might be mathematically calculated.

I shall mention under this Head but one thing more, which we may with all the Probability imaginable expect to arrive to, *viz.* the particular Seasons, Signs, and Places of the *Tornados* and *Hurricanes*. The Effect of these are in many Cases so fatal, that they call for all our Skill and Observation: And could the History hereof be so successively known, as that we might be able to draw any certain Conclusions from it relating hereunto, it might perhaps be a sufficient Recompence for all the Care, that is required, in the whole Collection of Marine Observations.

I might add in common to the two foregoing Heads, that the Marine Observations have much the Advantage of such as are made on Land, (which notwithstanding are of very great Service,) inasmuch as they are not obnoxious to any external Accidents, as these are; the Winds ashore being frequently interrupted in their Course, and often diverted therefrom, by intervening Mountains, Vallies or Promontories.

Were I allowed to reckon among the Advantages of this New Method of observing on the Winds and Weather, those incidental Observations, that might be found in Journals, of general Benefit to Mankind, they are perhaps alone sufficient to engage us in the Work. I shall only hint here, that if it should be thought proper to practise our Design, it may perhaps be worth the while to insert into the Meteorological Tables, such Observations as relate to the *Variation of the Compass* and *Currents*; the true Knowledge of which would be of no inconsiderable Service to *Navigation*.

If likewise there was a Column left for such remarkable Accidents as did occur, it might not be amiss; particularly, any uncommon Discoveries of Lands, Rocks, or Soundings; excessive Thunder and Lightening, &c. Luminous Appearances in the Sky; what Remarks may be found relating to the Water-Spout, which though perhaps one of the most curious Phænomena of Nature is as little known as any whatsoever; submarine *Hiatus* or Whirlpools, if any such there be; and lastly, any extraordinary Rendezvous of Fish, &c. that are used in the Affairs of Life, not to mention such Descriptions, as may relate to Matters of meer Speculation and Curiosity.



But these Sort of accidental Advantages, in such a Collection of Journals of Voyages, as is necessary to our Design, are too numerous to be insisted on : I shall therefore only add one more, which is the great Improvement there would hereby be given to *Geography*, a Science of the greatest Use and Importance in the Affairs of Life. Not only all *Hydrographical Charts* might be by this Means corrected, and brought to the Truth, which is of so much Concern, that the Lives of a great Part of such as go to Sea depend upon it ; but also, the Distances and Situation of all *Sea-Ports*, and many other Things, which are uncertain, or wanting in that Science, determined with the greatest Exactness. In a Word, *Geography* may, by such an Expedient, arrive, in a very expeditious Manner, to as great a Degree of Perfection, as it is capable of.

I shall have finished my Design, when I have taken Notice of the Method of determining the Degree and Strength of the Wind from such *Data* relating thereunto, as are to be found in *Sea-Journals* ; which in general is, from observing how many *Knots* the Vessel goes at the time of Observation ; which is always inserted in the *Day-Book* or *Journal* ; or, in other Words, what *Velocity* she then has ; for the Strength of the Wind may, with Exactness enough in this Affair, be judged of from the Effect it produces, or the Motion it communicates to the Ship. It is true, there will be some considerable Difference in this Respect, arising from the Shape and Burthen of the Vessel : However, as we do not expect a mathematical Exactness in this Article, after a little Use and Experience, together with comparing the greatest Velocities of different Ships together, a Person may seldom fail of judging of the Strength of the Wind, at least to a fourth Part ; that is, if according to the Method proposed in the foregoing Paper, the greatest Winds be expressed by 4, and the lightest by *Unity*.

In *Oblique Winds*, the Strength or Degree thereof will not be directly proportional to the Velocity of the Vessel, but must be corrected a little ; however, there will be no Difficulty in this Matter. For such as are acquainted with the Method of resolving *Oblique Powers* into *Direct ones*, may easily compose a Table of *Proportional Parts* suited thereunto. I did intend to have inserted such a Table ; but I am afraid I have already trespassed in the Length of this Epistle.

XXXIX In primis animadvertam, in tempore connotando, me *Meteorological* diei cujusque initium a meridie, ut Astronomi consuevere, suppu- *Observations,* tavisse : Observationesque in Ephemeridum meteorologicarum ad- *made for six* versaria referendas paulo post meridiem instituisse ; nisi quidpiam *years, at Pa-* me aliquando impedivit, aut tempestas aliqua a proposito me illo *dua, by Johan-* abduxit. *nes Marchio*

Veteri autem Stylo in temporibus designandis, & in mensuris *Polenus. No.* Anglico Pede ejusque Partibus, me usum fuisse, Institutum meum *421. pag. 201.*



fatis declarat. Si qua erunt, enarrationum progressu, ad tempus conveniens Novo Stylo, atque ad Gallicam mensuram referenda; de Styli atque mensuræ mutatione admonebo.

In mensura nivis, hanc liquefieri curavi; liquatamque ratione eâdem, ac pluviam aquam metitus sum.

Barometri mei tubulus satis amplus est, & Vasis, quo stagnans mercurius continetur, diameter est ferme vigecupla diametri tubuli: quamobrem ascendente intra eundem tubulum, & descendente mercurio, altitudo mercurij eo in vase tuto potest ceu invariata reputari.

Thermometrum meum ex genere illorum est, quorum inventio Gulielmo Amontonio, ornamento illustri Gallicæ Academiæ, adtribuitur. Tubulus est recurvus desinens in phialam, cujus phialæ pars inferior vivo argento, superior repletur aëre; hujusque dilata-tione vel majore, vel minore, pro varia caloris vi, mercurius in tubulo vel magis vel minus attollitur. Quoniam vero tubuli extremitas patula est; idcirco oportuit veram Thermometri Altitudinem ex Altitudine mercurij observatâ in Thermometri tubulo, Altitudine-que mercurij in Barometro, collectis in unam summam, compo-nere; inque Ephemerides referre Altitudinem eâdem plane ratione compositam. Est autem Thermometrum meum appensum ad parietem cubiculi (in quo vix unquam ignis accenditur) facie unâ ad meridiem alterâ ad orientem solem obversâ: neque enim aptum locum ad septentriones respicientem habeo. Thermometri mei phialâ intra glaciem immersâ subsidit mercurius in altitudine Dig. 47. Dec. 30. intra vero ebullientem aquam, ascendit mercurius ad altitudinem Dig. 63. Dec. 10. Porro iisdem semper Instrumentis, & ad eandem jugiter plagam constitutis usus sum.

Perspiciuum autem, si opus esset, ex modo relatâ & superioribus observationibus fieri posset; Hyemali rigidior tempore aërem nostrum ad frigus aquæ glacialis quamproxime accedere (ut alias in Com-mentariis Regiæ Scientiarum Gallicæ Academiæ An. 1711. pag. 2. observatum fuit, ab aëre suscipi eundem frigoris gradum, qui nivi convenit) æstivo autem tempore, aëris nostri teporem ab aquæ ebullientis calore distare plurimum: at id vel naturæ lumine notum est, atque manifestum.

Ventorum directiones singulis diebus adscripsi; eorum autem vires dumtaxat cum satis patentes, majores, vel maximæ fuere, nu-meris 2, aut 3, aut 4, pro magnitudine eorum signavi; prætermisso zero, sive malaciæ signo; & unitate, venti lenissimi indicio. Ce-terum, etiam me silente, nemo in hisce rebus vel mediocriter ver-satus non animadvertit; in infima hac prope nos aëris regione ubi Anemometrorum sedes est, sæpe unum aliquem ventum observari, dum in superioribus aëris regionibus alii diversique venti dominan-tur.



Post hæc vero monita, attingendo rem ipsam, ut aquæ pluviae, nec non ex fusa nive collectæ, quantitates (ut ferunt summæ ex observationibus desumptæ, singulis Mensibus convenientes) considerari queant; eas in subjectam Tabellam conjeci.

	1725.		1726.		1727.		1728.		1729.		1730.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
JAN.	0	521	1	355	5	955	4	278	1	085	0	12
FEB.			1	460	1	073	1	050	1	245	2	906
MAR.	0	889	3	168	1	878	4	832	2	902	4	592
APR.	4	019	3	998	0	498	1	419	2	768	1	638
MAY.	3	625	1	368	3	530	3	403	2	634	4	467
JUN.	0	036	2	608	2	476	2	103	3	134	6	205
JUL.	2	297	2	357	2	930	4	016	4	526	2	339
AUG.	5	185	1	268	5	067	5	186	0	578	4	269
SEP.	2	647	2	900	4	164	6	948	3	267	1	090
OCT.	7	104	0	179	6	576	5	163	6	294	5	254
NOV.	3	636	2	277	5	091	6	836	4	186	0	534
DEC.	0	030	2	390	7	169	7	599	2	804	0	894
Sum. totius anni.	29	989	25	328	46	407	52	833	35	423	34	300

Si iidem Menses illorum sex annorum colligantur in unam summam, comperietur ex Tabellâ minimam aquæ quantitatem decidisse Mensibus Februariis; quippe quæ non excefferit Dig. 7. Dec. 734. Maximam vero Octobribus Mensibus, quæ Dig. 30. Dec. 570, æquaverit. Præterea ex Tabellâ eâdem facile apparet, sicciorum annis aliis fuisse annum 1726, qui dedit aquæ Dig. 25. Dec. 328: aliis autem annis humidiorum fuisse Annum 1728, quo collegi aquæ Dig. 52. Dec. 833.

Numeros præterea quantitatum aquæ, singulis quæ anni Tempestatibus decedit, seorsum collegi; Tempestates ita partiens pro quocunque proposito anno; ut Hyemis initium referrem ad decimam diem Decembris anni præcedentis, & sic porro ad diem decimam Martij, Junij, atque Septembris Tempestatum reliquarum initia constituerem. Inventæ summæ, in Tabellâ, notatæ, sub oculis positæ sequuntur:



	Hyems.		Ver.		Æstas.		Autumnus.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
1725	0	912	8	167	7	584	13	327
1726	2	815	9	6	7	355	4	999
1727	8	181	5	916	11	875	15	497
1728	11	419	10	752	12	83	20	556
1729	7	470	9	430	6	310	13	617
1730	8	693	8	817	12	818	6	562
Sum.	39	490	52	88	58	25	74	558

Ex quâ Tabellâ proclive est noscere quantitatem aquæ pertinentis ad Æstatem & Autumnum, singulis annis majorem fuisse quantitate aquæ pertinentis ad Hyemem & Ver.

Quod si quantitates ad quamlibet Tempestatem pertinentes colligantur in unam summam; & deinde hæ summæ conferantur inter sese, facile liquebit, incrementa progredi eodem ordine ac Tempestates; ordiendo ad Hyeme; hoc est; Quantitatem minimam aquæ Hyemis tempore haberi, tempore autem Veris majorem, hanc vero superari ab Æstatis tempore, demum Autumnali tempore maximam reperiri.

Notum autem est & pervulgatum, pluviam a decrescente Barometri altitudine, serenitatem vero a crescente altitudine indicari. Ut igitur aliquo modo explorarem, quantum possint indicia illa, ut ex Barometro futuræ pluvie anticipata cognitio aliqua habeatur; dies, quibus pluit sex illis propositis annis collegi in varias summam pro Ventorum varietate, atque pro incremento aut decremento altitudinis Barometri a Meridie præcedentis Diei ad Meridiem Diei ejus quo pluit. Tabellam autem ipsam subjeci.

Decrescente Barometro a Meridie Diei præcedentis ad Meridiem Diei, quo pluit.

Numerus Dierum, quibus pluit.	Ventus qualis erat Meridie Dierum, quibus pluit.
86	N.
61	NE.
33	E.
28	SE.
44	S.
42	SW.
49	W.
35	NW.
378	Summa.

Crescente Barometro a Meridie Diei præcedentis ad Meridiem Diei, quo pluit.

Numerus Dierum, quibus pluit.	Ventus qualis erat Meridie Dierum, quibus pluit.
64	N.
41	NE.
16	E.
17	SE.
21	S.
15	SW.
20	W.
17	NW.
211	Summa.



Quâ absolutâ Tabellâ, miratus profecto sum inter numeros incrementi decrementique altitudinis Barometri non maiorem differentiam interesse quam ea, quæ inter 378 & 211 intercedit.

Fateor equidem; aliquoties crescente Barometri altitudine a præcedente Meridie ad Meridiem Diei, quo pluit, cœpisse tamen altitudinem eam decrescere post Meridiem Diei ejusdem, quo pluisset contigit: præterea vero incrementum illud aliquoties sumi posse, tanquam indicium futuræ, post haud longam pluviam, serenitatis: rationem etiam quantitatis pluviae esse habendam.

Sæpe tamen nulla ex hisce (ut ita dicam) excusatio præsto esse potest, ut fervetur constantia legis illius paulo supra indicatæ; qua a nonnullis sancitur, decremента altitudinis Barometri esse pluviae indicia, incrementa vero serenitatis indicia esse reputanda. Aliquid aliud detegendum adhuc est ad prænoscentia phænomena hæc. Quod si tamen deerit Observatorum industria, atque assiduitas, fortassis variationum hujuscemodi leges aliquando detegentur; & *veniet tempus, quo ista, quæ nunc latent, in lucem extrahat dies, & longioris ævi diligentia: & fortassis non erunt difficilia, ac Posterì nostri nos aperta nescisse mirabuntur.*

Nivalium postea Dierum, propositis sex illis annis contentorum comparisonem institui superioris illius similem; atque illud animadverti, quod Nix magis, quam pluvia, Barometri decrementis respondeat: ut in subiectâ Tabellâ videre est.

Decrescente Barometro a Meridie Diei præcedentis ad Meridiem Diei, quo nixit.		Crescente Barometro a Meridie Diei præcedentis ad Meridiem Diei, quo nixit.	
Numerus Dierum, quibus nixit.	Ventus qualis erat Meridie Dierum, quibus nixit.	Numerus Dierum, quibus nixit.	Ventus qualis erat Meridie Dierum, quibus nixit.
4	N.	4	N.
6	N E.		
1	E.		
1	S W.		
1	W.		
1	N W.		
14	Summa.	4	Summa.

Præterea vero, pro singulis annis summas altitudinum Barometri ac Thermometri confeci; ex quibus deinde altitudines medias convenientes singulis Diebus eorundem Annorum elicui; ut in subiectâ Tabellâ apparet.



	Summa Alti- tudinum Barometri.		Summa Alti- tudinum Thermometri.		Altitudo Media Barometri ad singulos dies.		Altitudo Media Thermometri ad singulos dies.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
1725	10854	26	18287	66	29	74	50	10
1726	10823	8	18268	93	29	65	50	5
1727	10831	17	18325	96	29	67	50	21
1728	10864	72	18419	81	29	68	50	33
1729	10842	23	18326	62	29	70	50	21
1730	10853	75	18264	18	29	74	50	4

Porro si Altitudines Barometri, non singulorum Annorum, sed omnium sex Annorum in unam tantum summam colligantur, invenietur, media Barometri Altitudo, singulis Diebus eorundem omnium annorum conveniens, esse Dig. 29. Dec. 70.

Ac si Thermometri Altitudines, non singulorum Annorum, sed itidem sex Annorum omnium colligantur in unam tantum summam, comperietur media Thermometri Altitudo singulis diebus eorundem omnium Annorum conveniens, esse Dig. 50. Dec. 16.

Quamobrem, inspectâ Tabellâ, facile est intelligere, Diales Medias Altitudines tum Barometri tum Thermometri, pertinentes ad annos singulos, paucissimis partibus differre a Dialibus Mediis Altitudinibus, quæ ex sex illis collectim sumtis proficiscuntur.

Maximam deinde Barometri Altitudinem Minimamque, itidem Thermometri Maximam ac Minimam Altitudinem in oppositam Tabellam redegi: ut uno aspectu conferri inter sese possent atque comparari.



Anni	Menses.	Dies S. V.	Hora	Maxima Barometri Altit. Dig. Dec.	Minima Barometri Altit. Dig. Dec.	Thermometri Altit. Dig. Dec.	Venti	Tempestas.
1725	JAN.	19	15	30 28	28 56	48 45	W.	Cœlum sudum.
	DEC.	8	15			47 98	SW 4	Cœlum nubibus fere obductum.
1726	NOV.	28	15	30 18		48 70	N.	Cœlum sudum.
	FEB.	13	15		38 92	48 62	S W.	Cœlum nubibus fere obductum.
1727	NOV.	20	15	30 24		48 88	N W.	Cœlum sudum.
	OCT.	29	3		28 80	49 6	S. 2.	Cœlum nubibus obductum.
1728	DEC.	2	15	30 20		48 98	N.	Nubes raræ.
	DEC.	12	15		29	48 60	N. W.	Pluvia tenuis.
1729	DEC.	20	15	30 30		48 88	W.	Cœlum nubibus fere obductum.
	NOV.	10	15		28 90	49 30	N.	Pluvia.
1730	DEC.	20	15	30 40		48 20	N.	Cœlum sudum.
	FEB.	27	15		28 98	48 78	S E.	Sol & nubes alternatim.

				Barometri Altitudo. Dig. Dec.	Maxima Ther. Altit. Dig. Dec.	Minima Ther. Altit. Dig. Dec.		
1725	JUL.	9	15	29 64	52 50		S. 2.	Cœlum sudum.
	DEC.	23	15	29 25		47 82	N E.	Sol & nubes alternatim.
1726	JUL.	15	15	22 74	52 40		S.	Cœlum sudum.
	JAN.	14	15	29 68		47 68	W.	Cœlum nubibus fere obductum.
1727	JUL.	13	15	29 60	52 18		E.	Sol paucæque nubes.
	JAN.	2	15	29 68		48 15	S. E.	Aër nebulosus.
1728	JUN.	22	15	29 68	52 54		S.	Sol paucæque nubes.
	DEC.	26	15	29 30		48 8	N. 2.	Cœlum nubibus fere obductum.
1729	JUN.	25	15	29 70	52 28		N E.	Cœlum sudum.
	JAN.	14	15	29 50		47 82	S W.	Cœlum sudum.
1730	AUG.	4	15	29 76	52 28		N.	Sol & nubes alternatim.
	DEC.	23	15	30 30		47 58	W.	Cœlum sudum.

Ut vero aquæ, quæ decidit, Quantitates conferri possent cum Quantitatibus iis, quæ in Regiæ Scientiarum Academiæ Commentariis regeruntur; Mensuras Anglicas in Gallicas transtuli, illas ad Regium Parisiensem Pedem (in Pollices atque Lineas divisum) referendo. Ac summas ad Annum quemlibet Novo Stilo computatum confeci, ut in subjectâ Tabellâ videre est.

Anni Stilo Novo.	Pol. Ped Paris.	Lin.
1725	28	1½
1726	23	2½
1727	42	11
1728	49	9½
1729	34	1½
1730	32	1½
Summa.	210	3½



Quare, si Pol. 210. & Lin.  $3\frac{1}{2}$ . dividantur in annos sex; Mensura Media Quantitatis aquæ, quæ decedit, conveniens singulis annis prodit Pol. 35. Lin.  $\frac{7}{12}$ . Mensura autem Media aquæ quæ cadit Lutetiæ Parisiorum (ut habetur in *Academiæ Commentariis Ann. 1711, 1714, 1715, & alibi*) Media, pro unius Anni curriculo Pollicum 19 esse computatur. Quamobrem Patavina Media Mensura Mediam Parisiensem excedit Pollicibus 16. Lin.  $\frac{7}{12}$ . Aut, si assumamus pro Mediâ Mensura Parisiensi Pol. 18. Lin. 8. (quemadmodum ex observationibus triennio habitis colligitur in *Commentariis Ann. 1719*) erit differentia Pol. 16. Lin.  $4\frac{7}{12}$ . Itaque plane liquet aquæ copiam hic decidere multo majorem, quam Lutetiæ Parisiorum.

Præstat etiam animadvertere, a Meridie Diei 23. (S T. Vet.) Augusti Anni 1727. (vento boreali) ad Meridiem sequentis diei, nimirum intra horas 24, decidisse pluviae Pol. 3. Lin.  $\frac{1}{2}$ . hoc est Lin.  $36\frac{1}{2}$ . Quæ sane pluviae copia multo major reperitur eâ, quæ intra horas 24. unquam decadat Lutetiæ Parisiorum: ut ex *Commentariis Regiæ Scientiarum Academiæ* colligere est.

Si maxima Barometri Altitudo Die 20 Dec. 1730. hic observata, redigatur ad Gallicam Mensuram, comperietur esse Pollicum 28. Lin. 6. minima vero Barometri Altitudo, quæ pertinuit ad Diem 8 Dec. 1725, invenietur Pollicum 26. Lin.  $9\frac{1}{4}$ . Quamobrem Mercurij in Barometro differentia inter Maximam Altitudinem, Minimamque colligetur Pollicum 1. Lin.  $8\frac{3}{4}$ .

Assumto itidem sexenio Observationum, quas in Regio Observatorio habuit Lutetiæ Parisiorum Philippus Hirius (nimirum ab Anno 1699 ad annum 1705) inveni Maximam Barometri Altitudinem extitisse Die 10 Dec. 1704. Pol. 28. Lin.  $4\frac{1}{6}$ . Minimam vero Die 20 Dec. 1703. Pol. 26. Lin. 5: atque ideo Mercurij in Barometro differentiam inter Maximam Altitudinem Minimamque fuisse Pol. 1. Lin.  $11\frac{1}{6}$ . Differentia itaque inter Maximam atque Minimam Mercurij in Barometro Altitudinem (attentis observationibus quas proposuimus) Lutetiæ Parisiorum inventa fuit major, quam Patavij Lin.  $2\frac{1}{12}$ . Et quidem jamdudum nonnulli fuere, qui observarent, illiusmodi differentias eo minores reperiri, quo magis loca, in quibus Observationes instituuntur, sunt *Æquatori circulo* vicina.

Reliquum nunc est ut ad aliud Observationum genus in Invitatione indicatum, hoc est ad Observationes Declinationum Magneticæ Acus, gradum faciam: ab hac tamen parte me paucis expediam. Notum hoc tempore est, atque inter hujusmodi rerum Peritos pervulgatum, variis unius ejusdemque Diei horis exiguas nonnullas mutationes in Acus Magneticæ Declinatione ita contingere, ut singulis integris Diebus eadem omnino constantissima Declinatio non observetur; sed paucis varietur aliquando Gradus sexagesimis: præterea vero compertum est, non ab omnibus Acubus (præsertim ad varios Magnetes affrictis) eandem prorsus penitusque exhiberi



hiberi Declinationem, sed aliquot (paucissimarum tamen cum ab excellentibus Artificibus Acus sunt elaboratae) sexagesimarum differentias aliquando comparere. Variationes itaque perexiguas ab hisce causis facile promanantes, si excipias, totis hisce sex solidis annis, Magnetis Declinationem versus Occasum Graduum tredecim observavi. Pyxis Magnetica, qua praesertim utor, & cujus (ut ita dicam) fidei plurimum tribuo, est Opus Bernardi Facini scientis Artificis, maxime harum rerum periti, maximeque industrii: cujus Pyxididis Acus longa est Pollices sex, granorum triginta duorum pondo. Hoc unum adjiciam, me suspicari (neque enim de tam exigua mutatione quidpiam secure affirmandum est) Declinationem Acus intra illud tempus, decrevisse decem sexagesimis potius, quam crevisse.

PART I. Containing METEOROLOGICAL OBSERVATIONS made at  
*Coventry,* } 1707. | *New-England,* }  
*Upminster,* } | *Upminster,* } 1715, 1716.

A TABLE shewing the Height of the Mercury in the Barometer, the Coast and Strength of the Winds, and the Weather, on the first Day of eight Months in the Years 1707 and 1708. Observed at Coventry in Warwickshire by Mr H. Beighton, F. R. S. and at Upminster in Essex, by W. Derham, F. R. S.

XL.  
*An Abstract of the Meteorological Diaries communicated to the Royal Society, with Remarks upon them by W. Derham, D. D. F. R. S. No. 423. P. 261.*

COVENTRY.				UPMINSTER.			
Month.	Barom.	Winds.	Weather.	Barom.	Winds.	Clouds.	Weather.
	Inch. Decim.			Inch. Cent.			
July.	29. 2 25 4	S 2 SW 3 2	Cloudy with Sunshine.	29. 39 36 52	S 2 W 7	SW SWbW	Showers and Stormy.
Aug.	5	W 1 NW 1	Fair Sunshine Day.	58 51	W b S 0		Fair and some Clouds.
Sept.	15 25	SW 5 4	Rain. High Winds.	33 29 38	S b W 5 W b S 8	SSW	Storms with Showers.
Octob.	05 05		Much Rain.	13 14 14	WSW 6 7		Stormy Day.
Nov.	85 85	W 4 W 1	Cloudy.	81 84 82	NWbW 1		Cloudy.
Decem.	05	SW 5	Rain. Warm.	21			
Jan.	05	E 1	Temperate and Misty.	01 06	NNE 0		Cloudy dark Day.
Febr.	65	N 2	Clear. Cold with Snow.	62 59 52	NNE 3 3		Frost and Snow with Fair.



*A TABLE shewing the Coasting and Strength of the Winds and the Weather every first Day of the Month in the Year 1715, and the Quantity of Rain in that Month, observed at Harvard-College in Cambridge in New-England, by Mr Tho. Robie; and the Height of the Mercury in the Barometer, the Coasting and Strength of the Winds and Clouds, the Weather and Rain at the same Time at Upminster, by W. Derham, D. D. F. R. S.*

HARVARD-COLLEGE.				UPMINSTER.				
Month.	Winds.	Rain.	Weather.	Barom.	Winds.	Clouds.	Rain.	Weather.
		Lib.	Cent.					
Jan.	WN W W b N S	5.	17	30. 11 10 14	NE 3 2		4. 31	Hard Frost and Cloudy.
Febr.	S W 1 S W 3 W 0	12.	92	29. 75 30. 10	WSW 7 10		3. 7	Stormy.
March.	W 1 S W 1 SW b W 1	5.	14	29. 40 48 40	ENE 3 4		12. 53	Cloudy. Mistling. Rain.
April.	NW b W 5	12.	71	65 60 46	S b W 1 E 3	S.	13. 19	Fair with Cloudy.
May.	Calm. E 3 E 4	13.	14	32 39 30	S b E 4 SW 2		4. 66	Rain. Fairer.
June.	SW 2 WNW 0 SW 1	13.	63	69 69 72	NNW 0 NW 2	SW.	16. 34	Fair with Cloudy.
July.	NW b W 3	14.	42	65 71 77	W 1 N W 1		20. 00	Cloudy. Thunder and Rain.
August.	NW 0	9.	64	30 28 28	N W 0	SW.	20. 49	Fog. Rain. Fairer.
Sept.	NE 0 E 1 0	Sept. and		55	S SW 4		9. 17	Fair. Rain.
Octob.		Octob. 30.	78	75 72 50	WSW 0 1		14. 08	Hoar Frost. Fair. Rain.
Nov.	W 0 NW 1 N 1	7.	24	54 54 38	SW 0 W b N 1		8. 53	Rain. Cloudy.
Dec.	W 3 WNW 3 W 1	5.	83				2. 55	Fair and Cold.



A TABLE of the like Observations in the Year 1716, as those in the preceeding Table, except the Rain in New-England which Mr Robie omitted.

HARVARD-COLLEGE.				UPMINSTER.				
Month.	Wind.		Weather.	Barom.	Winds.	Cloud.	Rain.	Weather.
							Lib. Cent.	
Jan.	N W <sup>2</sup> N W <sup>2</sup>		Cold and Clear.	29. 62 59 76	WbN <sup>0</sup> NbW <sup>0</sup>		8. 61	Thaw with Mistling & Cloudy.
Febr.	NWbW <sup>1</sup> N <sup>0</sup> E <sup>0</sup>		Cold hard Frost.	30. 15 18 21	NNE <sup>2</sup> <sup>1</sup>		1. 76	Black Clouds.
March.	E <sup>0</sup> N <sup>0</sup> N W <sup>1</sup>		Rain. Fairer.	29. 42	WbN <sup>0</sup>		1. 93	Fair.
April.	S E <sup>1</sup> N W <sup>6</sup>		Cloudy. Fair.	85 85 80	E b S <sup>1</sup> E S E	S. S.	5. 04	Fair and Pleasant.
May.	N <sup>0</sup> E <sup>1</sup> S <sup>2</sup>		Fair.	30. 00 29. 97	N <sup>2</sup>		9. 52	Fair warm Day.
June.			Rain.	94 98 30. 01	NNW <sup>1</sup> NbE <sup>4</sup>	NNW	8. 24	Cloudy. Rain. Fairer.
July.	N W <sup>1</sup> 0		Fair and Cool.	29. 91 92 90	N W <sup>0</sup> W <sup>3</sup>	N b E	4. 47	Fair Pleasant Day.
Aug.				88 88 92	WNW <sup>1</sup> N W <sup>4</sup>	N W	2. 11	Cloudy. Fairer. Cloudy.
Sept.	S W <sup>2</sup> 6 4		Fair and some Clouds.				9. 87	
Octob.	W <sup>1</sup> S W <sup>2</sup> S <sup>1</sup>		Fair. Hoar-Frost.	51 52 50	W b S <sup>0</sup> <sup>0</sup>		15. 75	Clofe dark Day. Rain.
Nov.	W <sup>1</sup> WNW <sup>1</sup> 1		Fair and Pleasant.				4. 41	
Dec.	N <sup>1</sup> N E <sup>2</sup>		Cold and Raw. Snow.	68 87	NbW <sup>2</sup>		7. 16	Frost and Fair.



REMARKS  
on the foregoing  
TABLES.

In that for  
the Year 1707

I. I observe there is a great Agreement between the *Barometers* at *Coventry* and *Upminster*, in their *Rising* and *Falling* near the same Time, at least not many Hours before or after one another, and for the most Part in the same Proportion. Also when one is *Stationary*, the other is so too, especially if of any Continuance: But at *Coventry* the *Mercury* is lower than at *Upminster* about a tenth of an Inch, the Situation at *Coventry* being, I suppose, higher than that of *Upminster* about 82 Feet, according to my Experiments in *Philos. Trans.* N<sup>o</sup>. 236.

II. I observe also a greater Conformity between the Winds, than (considering the Causes of their perpetual Change) would be imagined. For although they may vary a Point or two, yet generally through all the eight Months, they tended nearly towards the same Point of the Compass, and changed in one Place as they did in the other; especially when they blew strongly, or were of some Continuance. I have observed, that a Storm in one Place is so in the other; of which the Diaries at large give many Examples; and in this Table of 1707, in the Months of *September* and *October*, where Mr *Beighton* hath noted the Wind's Strength to be three and four, it is about the same Strength with mine of five, six, seven and eight, I taking in more Degrees of the Strength of the Winds than he.

III. I observe also, that the Weather in each Place is for the most Part nearly the same.

IV. I have often observed, that the Falling of the *Quicksilver* in dark and cloudy Weather betokeneth Rain; but the Rain is always preceded with Fair Weather: And when the Fair comes, the Foul is not far off. And this chiefly happens, when the Wind is in any of the Easterly Points.

V. In *January* 170<sup>6</sup>, many were troubled with cuticular Eruptions, which itched much. After this the Measles were epimedical 'till the latter end of *May*.

VI. The Beginning of this Year being very dry, and often the Weather cold (as appears by my Tables at large) Hay was scarce, and became very dear.

VII. *July* 8, commonly called the *Hot-Thursday*, was the hottest Day that hath happened since I began my Meteorological Observations. A young Man working in Harvest harder than ordinary, was overcome with the Heat, and died: And divers Horses on the Road that Day, dropped down, and died also.

VIII. In *November* and *December* the Air being moist, and frequently cold, Coughs were epidemical with us.

IX. I hope I shall be excused if I go out of the Bounds of this Table, and observe that the unseasonable Frosts in *April* 1708 (particularly *April* 25th and 26th) blasted the tender young Leaves and Catkins of the Oak, Walnut-Tree, &c. which I take to be the Reason that few Acorns and Walnuts were that Year. From whence  
it



It is a just Conclusion, That the *Catkins* are of greatest use to the Fertility of such Trees that bear them; but whether as a Male-Sperm I shall not determine.

*Catkins of use to the Fertility of Trees.*

X. This Month of *April* also Horses were every where seized with dangerous Coughs; of which many died in *London*, and other Places, especially such as laboured on the Roads. I have great Reason to think these Colds were catching, because my Horses that went well to *London*, returned with great and sudden Colds.

XI. *June 11* (although it was the Day of the Summer Solstice) was ensued with a very cold Night, my Thermometer descending nearly to the Point of an Hoar-Frost.

The late ingenious Mr *Robie*, at my Request, was pleased to make, *REMARKS* in *New-England*, *Meteorological Observations*, Morning, Noon, and Night, to correspond with mine at the same Time at *Upminster*.

*on the TABLES of 1715 and 1716.*

These Observations he made in 1715 &c. to the End of 1722, and ordered them to be sent to our *Royal Society*; and accordingly I received them, not long since, from his ingenious Successor at *Harvard-College*, Mr *Is. Greenwood*, and now present them, with my own, to the *Society*.

But by reason they are too long to be read at the *Society's Meetings*, or to be inserted in the *Transactions*, I have therefore made the foregoing Extract from them, together with some Observations of my own, which tally with them.

But I am sorry that Mr *Robie's* Observations want those of the Barometer and Thermometer: Neither of which Instruments was to be gotten in *New-England*. Could we have had those Observations, they would have been of great use in several Phænomena of those distant Places, which now I can only guess at: And,

I. I guess, that notwithstanding *Harvard-College* is ten Degrees more South than *Upminster* (it being, as Mr *Robie* says, in *Lat. 42 Deg. 25' North*, and *Longitude from London 4<sup>h</sup> 44'* as corrected by the best Observations, that I say) they have as cold, if not colder Seasons than we have here.

II. Although the ordinary Agreement or Disagreement of the Winds, deserves no Remark, yet it may deserve Observation, That when the Winds have continued long in one Point, they have nearly agreed in both Places, and especially when they have been high, and strong for some time. In which Case I have observed, that there have been some Days Difference in the coming of those Winds, as if they were so many Days in their Passage from Place to Place.

And this Agreement of the Winds, together with that of the Ascent and Descent of the Quicksilver before-mentioned, divers curious Observers have taken Notice of, as well as my self, between distant Places, though not so far as *New-England*; as *Zurich*, *Paris*, *Lancashire* and *Upminster*; as may be seen in the *Philos. Transact.* particularly Numb. 208, 286, 297, and 321.



III. I observe, that they have in *New-England* many more *Parbelij*, *Halo's*, *Lunar Rainbows*, and such like Appearances: Also more *Earthquakes*, *unusual Meteors*, *Thunder and Lightening*, than we have.

IV. The Rain in 1715 (which was the only Year in which Mr Robie observed it) in the different Months, amounted to different Quantities; but in the whole Year, it was nearly the same as at *Upminster*; that at *Harvard-College* being 130,64 *lb*, that at *Upminster* 128,92 *lb*, But considering that Mr Robie's Tunnel that received his Rain, was but 11  $\frac{1}{2}$  Inches in Diameter, and mine exactly 12, therefore the Proportion of the *New-England* Rain may be accounted somewhat the greater.

V. I observed at *Upminster*, that in *January* the Contagion which was very fatal among the *Black Cattle* about *London* the latter End of the last Year, came amongst us, and destroyed many.

In *March* many were afflicted with *Head-aches*; and the *Small-Pox* was epidemical: And the Earth being very dry, the Ponds empty, and the Springs low, in that and the next Month there fell good Store of seasonable Rain, as the Table for that Year shews, but not sufficient to fill the Ponds. But in *June*, *July* and *August*, more Rain fell than was welcome; which filled the Ponds, but hurt the Hay, and Corn, and made the Ways as dirty as in Winter.

In the Summer this Year I had many Confirmations of some former Observations in my *Physico-Theology* Lib. I. Ch. 3. viz. That a cold Summer is commonly a wet one. Which this Summer was, the Spirits in the Thermometer being often low, particularly near the Point of *Hoar-Frost* on *August* 12.

In *January*, the following Year 1716, the River of *Thames* was frozen for several Miles, and particularly so intensely at *London*, that whole Streets of Booths were erected on the Ice, Oxen roasted, Coaches driven, and many Diversions, exercised above Bridge. And so strong was the Ice below Bridge, as to allow People to walk and skate at their Pleasure thereon. But yet the Spirits in the Thermometer descended not all the while near so low, as on *December* 30, 1708.

In *Scotland* also (which in 1708 felt but little of that Year's severe Frost) the Ice was strong enough to bear the Horse and Foot of the Armies.

And beyond Sea they suffered much; particularly in *Spain*, much Mischief was done by the wild Beasts, which were forced by the Frost out of the Woods.

Among *Birds* I find the *Goldfinches* to have suffered much, having scarce seen one of them all the following Part of the Year; they being killed by the hard Weather, or driven to seek Food in other Parts.

On the — Day of —, the Wind was so violent, that the *Thames* was emptied from *London-Bridge* as far as —, so that only a small Rivulet of Water, no bigger than a Brook of 10  
or



or 12 Foot over, remained; infomuch, that People walked on the Bottom, and found Treasure there.

In November and December Pleurifies were frequent, and mortal in our Parts of *Essex*. The Weather was mild, open, dark, and damp for the most Part, with now and then a cold Day or two.

On February 12, 171 $\frac{5}{8}$ , he notes an *Earthquake* to have been at *Farther Re-Salem Village*; and on Octob. 21 following the Day was so dark, that marks from People were forced to light Candles to eat their Dinners by. Which could not be from an Eclipse, the Solar Eclipse being the 4th of that Month. *Mr Robie's Papers.*

On Feb. 13, 171 $\frac{6}{7}$ , he observed an Immersion of the first Satellite of *Jupiter*, at 10<sup>h</sup> 48' 17''; and on Feb. 8. I observed an Emerfion at 8<sup>h</sup> 7' 30''; according to which the Difference of Longitude between *Harvard-College* and *Upminster* is 4<sup>h</sup> 45', and Mr. Robie says, that it is 4<sup>h</sup> 44' from *London*, by the latest and best Observations.

Sept. 23, 1717, Mr. Robie observed the Solar Eclipse.

The Beginning at 12<sup>h</sup> 23'

The Middle at 1<sup>h</sup> 47 or thereabout.

The End at 3<sup>h</sup> 5' 10'' p. M.

About 9 Digits were eclipsed.

Octob. 5, following he observed the Southing of the Moon, at 9<sup>h</sup> 32' p. M.

On Feb. 25, 171 $\frac{7}{8}$ , Mr. Robie saw the Moon cover *Aldebaran* at about 9<sup>h</sup> 18' p. M. and the Star to emerge at 10<sup>h</sup> 20' p. M. then by his Meridian Instrument (such as I have described in *Philos. Transf.* Numb. 291) being 2' too slow, so that 2' are to be added to the Time mentioned.

March 10, 171 $\frac{7}{8}$ , Mr Robie observed an Emerfion of the first Circumjovial at 10<sup>h</sup> 45' 35''.

Sept. 24, 1718, Mr Robie observed the Moon to South at 9<sup>h</sup> 38', or thereabout: On the 25th at 10<sup>h</sup> 22' 32'' p. M. On the 26th at 11<sup>h</sup> 26' p. M.

Decemb. 5, a great fiery Meteor was seen in the Morning about Break of Day. And on the 9th, about half an Hour after Ten, in the S S W, he saw another which made a Light like the Moon.

Dec. 19, the Moon southed at 6<sup>h</sup> 45' 45'' p. M. On the 20th at 7<sup>h</sup> 30' 56''. On the 23d at 9<sup>h</sup> 54' 5''. On the 25th at 11<sup>h</sup> 47' 33''.

On Jan. 13, 171 $\frac{8}{9}$ , the first Circumjovial immersed at 10<sup>h</sup> 35' p. M.

Jan. 17, The Moon southed at 5<sup>h</sup> 52' 1''. On the 19th at 7<sup>h</sup> 33' 1''. On the 22d at 10<sup>h</sup> 21' 40'' p. M.

Feb. 16, Moon southed at 6<sup>h</sup> 15' 15'': On the 19th at 8<sup>h</sup> 59' 40'': On the 21st at 10<sup>h</sup> 54' 30'' p. M.

On Dec. 11, 1719, a very unusual Meteor was seen in the Evening

On Jan. 8, 17 $\frac{20}{20}$ , Mr Robie says there was an *Earthquake*.



On Nov. 24, 1720, Mr Robie observed a *Streaming* from the Northern Horizon; as I did on Nov. 22, before.

Fig. 25.

On Dec. 10, 1720, about 8<sup>h</sup> p. M. Mr Robie first saw the Light that strikes up toward the *Pleiades*; and on Jan. 6, following, he found it was increased, and almost reached to the *Pleiades*. And Dec. 7, 1721, he observed the same; and on the 25th he hath given this Figure of it: *bo* is the Part next the Horizon; *V* the Point toward the *Pleiades*.

This *Glade of Light* is the same that Dr Childrey mentions in his *Briton. Bacon.* under the Name of *Semita luminosa*; and which I saw, and gave a Figure of in *Philos. Trans.* Numb. 305.

Observations  
of the Eclipse  
of the Moon  
on June 28,  
1721.

About Two in the Morning Mr Robie viewed the Moon with his eight Foot Telescope, and she was untouched.

## Time Correct.

H.	I	II	
2	10	00	A thin Penumbra.
2	12	00	Shadow is plainly entered.
2	18	10	<i>Palus Mareotis</i> covered.
2	31	40	<i>Mons Porphyritis</i> touched.
2	34	20	— — — covered.
2	47	10	Moon eclipsed about six Digits.
2	49	05	<i>Besbicus</i> just touched.
2	50	30	— — — covered wholly.
2	53	40	<i>Byzantium</i> touched.
2	54	10	— — — covered.
3	05	40	<i>Palus Mæotis</i> touched.
3	18	30	Moon wholly covered.

There remained a Light on the Western Side of the Moon for some Time.

About 3<sup>h</sup> 50<sup>l</sup> in the Morning the Moon was wholly hid by the Haze, and coming on of Day-Light, that nothing could be seen of her; although from the Immersion 'till now she was visible.

The Observa-  
tions Mr Robie  
made on the  
Solar Eclipse,  
Nov. 27,  
1722, were as  
follows.

H.	I	II	
7	27	00	He saw the Sun rise eclipsed about four Digits on his supreme Vertex; to the S W the greatest Part of the Shade lay.
			Then we could observe no more 'till
8	30	00	The Sun began to appear, and six Digits, or thereabouts, were eclipsed.
8	55	15	The Sun was eclipsed $4\frac{3}{4}$ nearest; and then the Sun's Diameter was to the Moon's, as 1000 to 972.



9 00 15 Were hid  $4\frac{1}{2}$  nearly; and the Sun's Diameter was to the Moon's as 1000 to 975.

9 19 45 A little Spot on the Sun emerged.

9 25 45 I saw the Moon go off the Sun, and Mr *Danforth* at the same Time: And Mr *Appleton* at

9 25 20

XLI. It being the Opinion of divers skillful Naturalists (particular-ly Mr *Fr. Willughby* and Mr *Ray*) that the *Ignes Fatui* are only the Shining of a great Number of the *Male-Glowworms* in *England*, or of the *Pyraustæ* in *Italy*, flying together, I was minded to consult my curious and ingenious Friend, Sir *Tho. Dereham*, about the *Phænomenon*, being informed, that those *Ignes Fatui* are common in all the *Italian* Parts. But of the *Pyraustæ*, or *Fire-flies*, he saith, He never observed any such Effects, although there is an immense Number of them in June and July. He saith moreover, that these *Pyraustæ* are called *Lucciole*, i. e. *Small Lights*, and that they are not the *Farfalls* (as Mr *Ray* thought) which are *Butter-flies*.

*Of the Meteor called the Ignis Fatuus, from Observations made in England, by the Rev. Mr W. Dereham, F. R. S. and others in Italy, communicated by Sir Tho. Dereham, Bart. F. R. S. No. 411. pag. 204.*

But I have good reason to think, that Insects are not concerned in the *Ignes Fatui*, from the following Observations; the First of which I made my self, and the others I received from *Italy*, by the Favour of Sir *Tho. Dereham*.

My own Observation I made at a Place that lay in a Valley between Rocky Hills, which I suspect might contain Minerals, in some boggy Ground near the Bottom of those Hills. Where, seeing one in a calm, dark Night, with gentle Approaches I got up by Degrees within two or three Yards of it, and viewed it with all the Care I possibly could. I found it frisking about a dead Thistle growing in the Field, until a small Motion of the Air (even such as was caused only by the Approximation of my self) made it skip to another Place, and thence to another, and another.

It is now about fifty-five Years since I saw this Phænomenon, but I have as fresh and perfect an Idea of it, as if it was but of a few Days. And as I took it then, so I am of the same Opinion now, that it was a *fired Vapour*.

The *Male-Glowworms* I know emit their shining Light, as they fly; by which Means they discover and woo the Females: but I never observed them to fly together in so great Numbers, as to make a Light equal to an *Ignis Fatuus*. And I was so near, that had it been the Shining of Glowworms, I must have seen it in little distinct Spots of Light; but it was one continuous Body of Light.

Having thus related my own Observations of the *Ignes Fatui*, I shall next give an Account of the Observations which Sir *Tho. Dereham* procured for me in *Italy*, in the following Letter of Dr *Giacomo Bartholomeo Beccari*, F. R. S. to Sir *Tho. Dereham*, F. R. S. dated at *Bologna*, Octob. 23, 1728.



**I**T is purely in Obedience to your Commands, by Dr *Eustachio Manfredi*, I send you the following Observations on the *Ignes Fatui*. What I am now going to offer to you concerning these fiery Appearances, is the Result of several Conversations I had upon this Subject with several experienced Travellers, Men of Learning and Reputation, whose Sincerity I had no Reason to mistrust. For my own farther Satisfaction, ever since I received your Commands, I have made it my Business to speak with as many as I could light of, with such as travelled much in the Mountains, and with others that observed them in Plains, on Purpose to see whether or no the Difference of the Place made any sensible Difference in the Appearance. I find upon the Whole, that they are pretty common in all the Territory of *Bologna*. To begin with the Plains, they are very frequently observed there; the Country People call them *Cularsi*, perhaps from some fancied Similitude to those Birds, and because they look upon them as Birds, the Belly and other Parts of which are resplendent like our shining Flies. They are most frequent in watery and morassy Ground, and there are some such Places, where one may be almost sure of seeing them every Night, if it be dark. In the Fields near the Bridge *Della Calcarata*, in a Common belonging to the Parish of *S. Maria in dono*, North of *Bologna*, one of these fiery Appearances is very often observed to move a-cross the Fields, coming from another Bridge, called *Della Fossa quadra*. There is another of them in the Fields of *Bagnara*, almost East of *Bologna*, which scarce ever fails to appear in dark Nights, particularly when it rains, or snows, as also in cold and frosty Weather. Both these, I mean that near the Bridge of *Calcarata*, and that in the Fields of *Bagnara*, are very large; and I am assured, that sometimes their Light is equal to that of one of our ordinary Faggots or Bundles made of Branches of Vines, and that it is scarce ever less than that of the Links which our Country People make of Hemp-stalks, and which they light themselves withal, when they travel at Night. That at *Bagnara* appeared, not long since, to a Gentleman of my Acquaintance, as he was travelling that Way; it kept him Company for a Mile or better, constantly moving before him, and casting a stronger Light on the Road, than the Link he had with him.

I believe there may be many more in other Plains as large as these two, though at present I have not been able to get certain Information of any others. Lesser ones there appear a good many, some of them giving as much Light as a lighted Torch, and some there are no bigger than the Flame of a common Candle. Of these, I have been assured, a good many were seen in the Fields of *Barisella*. All of them have the same Property in resembling both in Colour and Light, a Flame strong enough to reflect a Lustre upon Neighbouring Objects.



jects all round. They are continually in Motion, but this Motion is various and uncertain. Sometimes they rise up, at others they sink. Sometimes they disappear of a sudden, and appear again in an Instant in some other Place. Commonly they keep hovering about six Foot from the Ground. As they differ in Largeness, so they do in Figure, spreading sometimes pretty wide, and then again contracting themselves. Sometimes breaking to all Appearance into two, and a very little while after meeting again into one Body; sometimes floating like Waves, and letting drop some Parts like Sparks out of a Fire. I have been assured, that there is no dark Night all the Year round, when they do not appear. And in the very Middle of the Winter, when the Weather is very cold, and the Ground covered with Snow, they are observed more frequently than in the hottest Summer. The Gentleman who obliged me with an Account of that at *Bagnara*, told me, that if I had a Mind to see it my self, I might be sure of finding it if I went thither in very cold Weather, and in a sharp Frost. Nor doth either Rain or Snow in any wise prevent or hinder their Appearance; on the contrary, they are more frequently observed, and cast a stronger Light in rainy and wet Weather. This last Circumstance indeed hath been taken Notice of by some Writers, and among the rest, if I remember right, by the learned *Gassendi*. Neither doth the Wind much hurt them, though one should think, that if it was a burning Substance, like common Fire, it should either be dissipated in windy Weather, or extinguished by Rain. But since they do not receive any Damage from wet Weather, and since, on the other Hand, it hath never been observed, that any thing was thereby set on Fire, though they must needs in their moving to and fro, meet with a good many combustible Substances, it may from thence be very reasonably inferred, that they have some Resemblance to that Sort of Phosphorus which doth indeed shine in the dark, but doth not burn any thing as common Fire doth. Nor is there any thing extraordinary in this, any more than in other fiery Appearances, which I am informed are likewise pretty common, and agree with the *Ignes Fatui*, in having only the Splendor and Appearance of Fire, without the Quality of Burning, but differ from them in a good many other Particulars. Such a Phænomenon was observed by a noted Clergyman of this City, one Summer's Evening, near some Country Peoples Houses. The Flame seemed to him so strong, that he called to them to put it out, for fear it should reach a Hay-loft; and a Heap of Hemp that lay not far from it; but when he came to the very place where he had first seen the Flame, he perceived that it was only an Appearance, observing not the least Footstep of Fire, though he assured me there lay a good deal of combustible Stuff all thereabouts, which would have easily took Fire, if there had been any thing of an actual Flame upon the Spot. The same Gentleman told me, that in a very dry Summer (I do not know whether the



the same with the foregoing) he observed, in the Middle of some other Fields of his own, for several Evenings together, a pretty considerable Flame on the Ground, nearly in the same Place, and that having resolved to go and take a nearer View of it the next Evening, it did not appear for that Time; that, however, he went to the Place where he had before seen it, and sat himself down on the Ground, but could not observe the least Mark of any Fire or Flame having been in that Spot, nor feel any Heat in the Ground any more than in other Places; only he saw some slight Flames arising out of the Ground hard by, which disappeared as soon as they came into the open Air. It is well known to People that travel on Horseback at the Beginning of the Night, in the Heat of the Summer, when they traverse the dry Beds of Rivers, and break with their Horses Feet those sandy Grounds that have been all Day long strongly heated by the Sun, there rise up some bluish Flames, which very often fright the Horses. This Phænomenon is most common in those Places where the Water hath left behind a kind of a chalky Sediment, or fat Earth, which drying, afterwards forms a thick hard Crust. So likewise if in the Heat of the Summer you travel in dark Nights, either on Horseback, or on Foot, over the burnt-up Ground of some Fields, you shall see Flames break out of the Ground almost at every Step. All these Fires and Flames have indeed the Light and Shining, but not the Burning Quality of Fire, whether from the extream Smallness and Rarity of their Parts, as some apprehend, or for some other Reason, I will not attempt to determine. And this is the only thing they have in common with the *Ignes Fatui*, differing very much in other Respects, particularly in not appearing at all Seasons of the Year, and most frequently in the Winter, as the others do. Thus far, what I could learn concerning the *Will with a Wisp*, as it hath been observed in the Plains. As to the Appearance of this Phænomenon in mountainous Parts, by what I have hitherto been able to learn, they differ in nothing else but in Largeness; and all those I conversed with, that saw them in the Mountains, agree in that they never observed any larger than the Flame of an ordinary Candle. Nor do those that live in the Mountains call them *Cularsi*, which Name is perhaps used only by the Country People in the Plains for those large ones above described. I will make it my Business to enquire a little farther into this Matter, if perhaps the large ones are seen in the Plains only, and those in the Mountains are always small. The Difference of the Air, and that of the Soil may, for ought I know, contribute a great deal towards the different Size of these Appearances; at least all that I can offer material at present towards solving this particular Circumstance, with Regard to their Largeness, is, that those Grounds, where we observe the largest Fires, as at *Bagnara*, are what they here call *strong Ground* (*terreni forti*) being a hard chalky and clayey Soil, which will harbour the



Fig. 15.

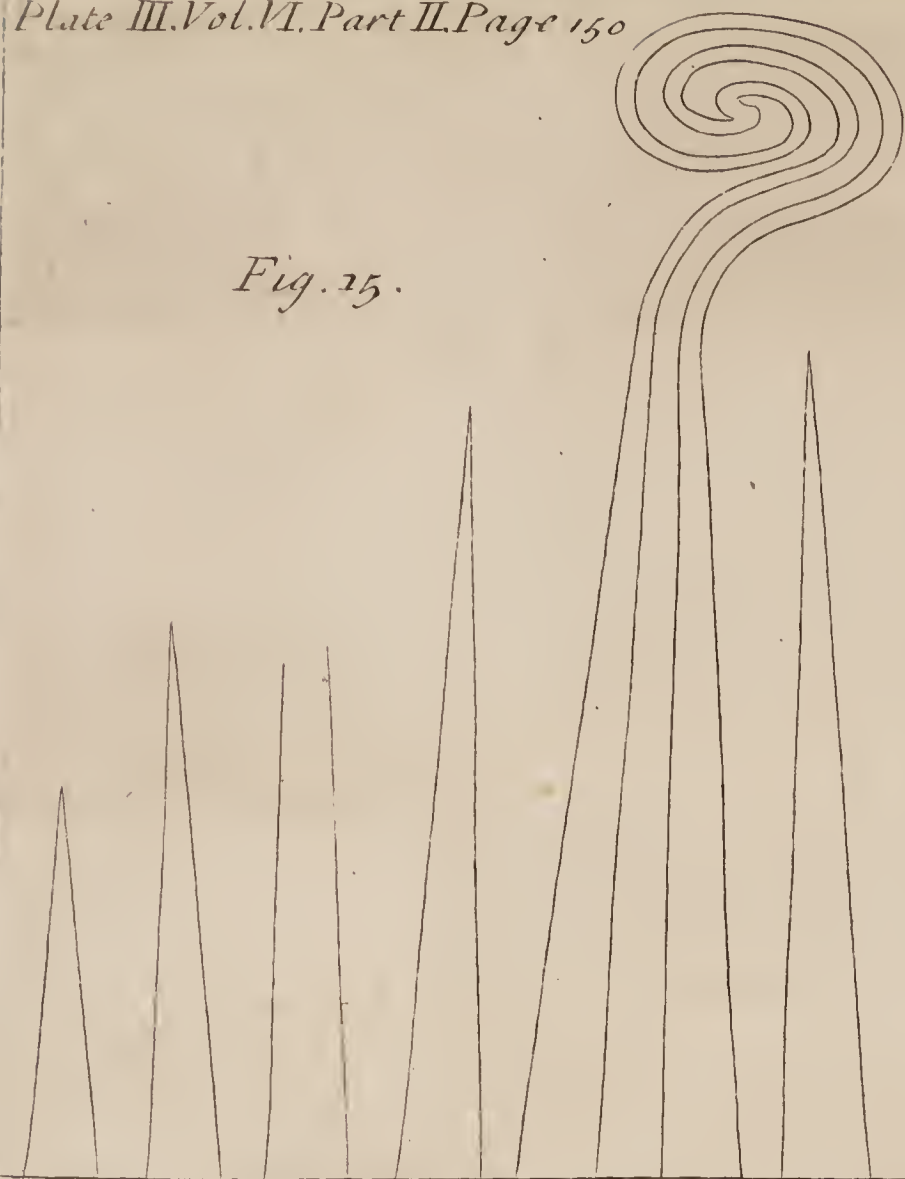


Fig. 17.

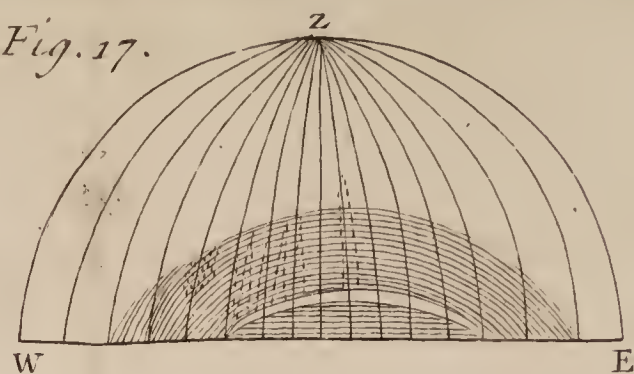


Fig. 18.

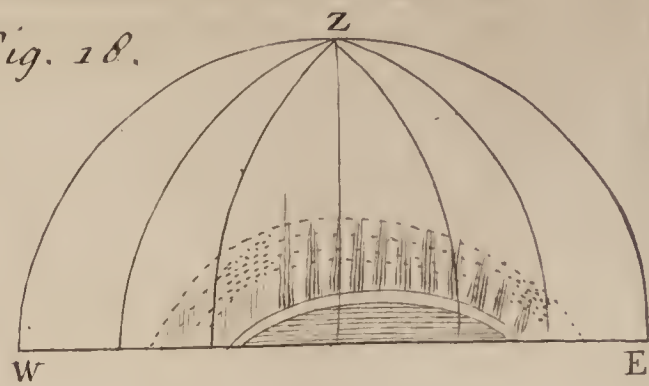


Fig. 19.

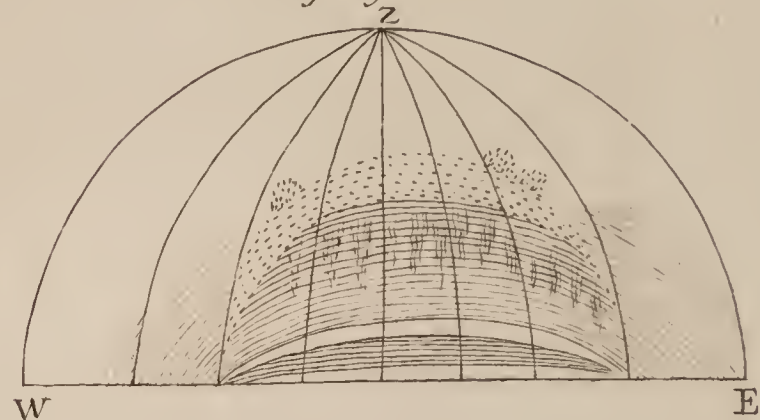


Fig. 20.

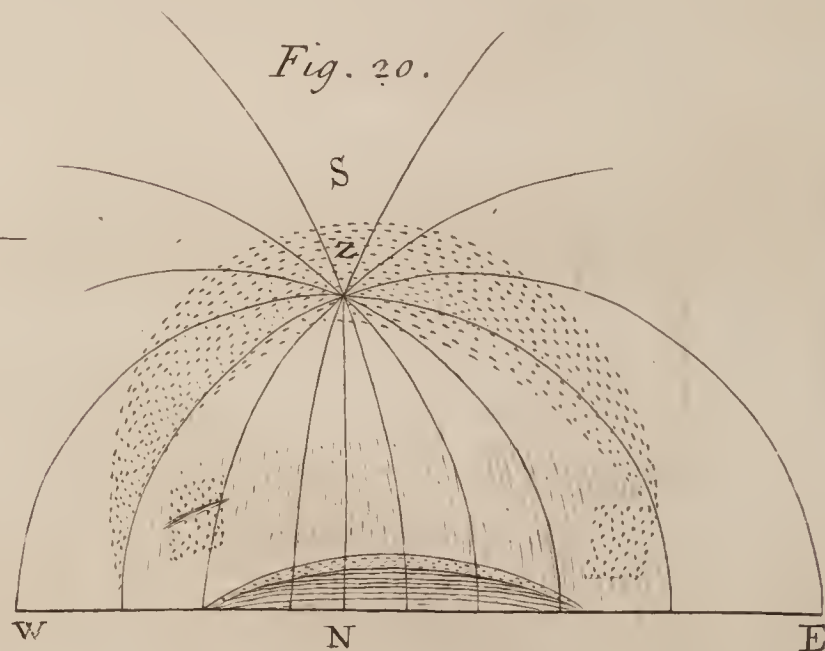


Fig. 21.

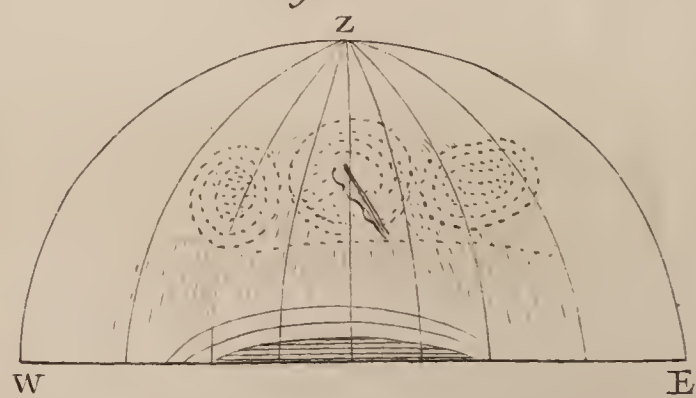


Fig. 22.

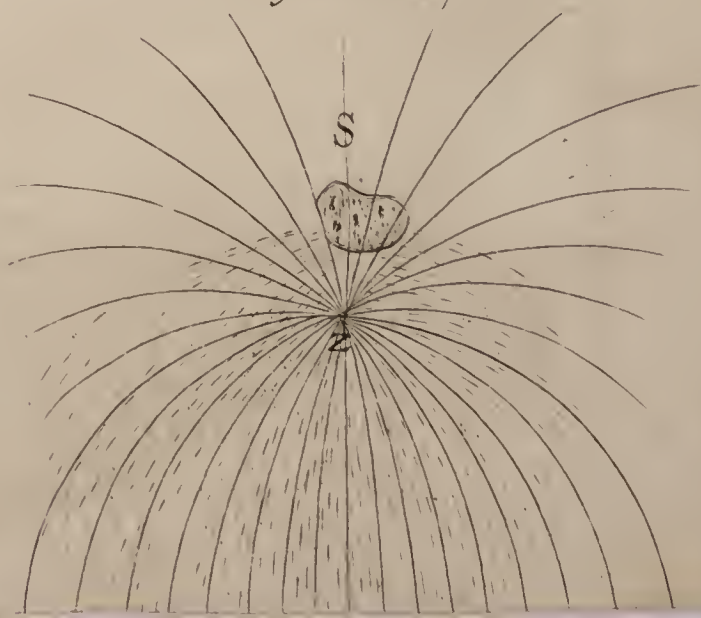
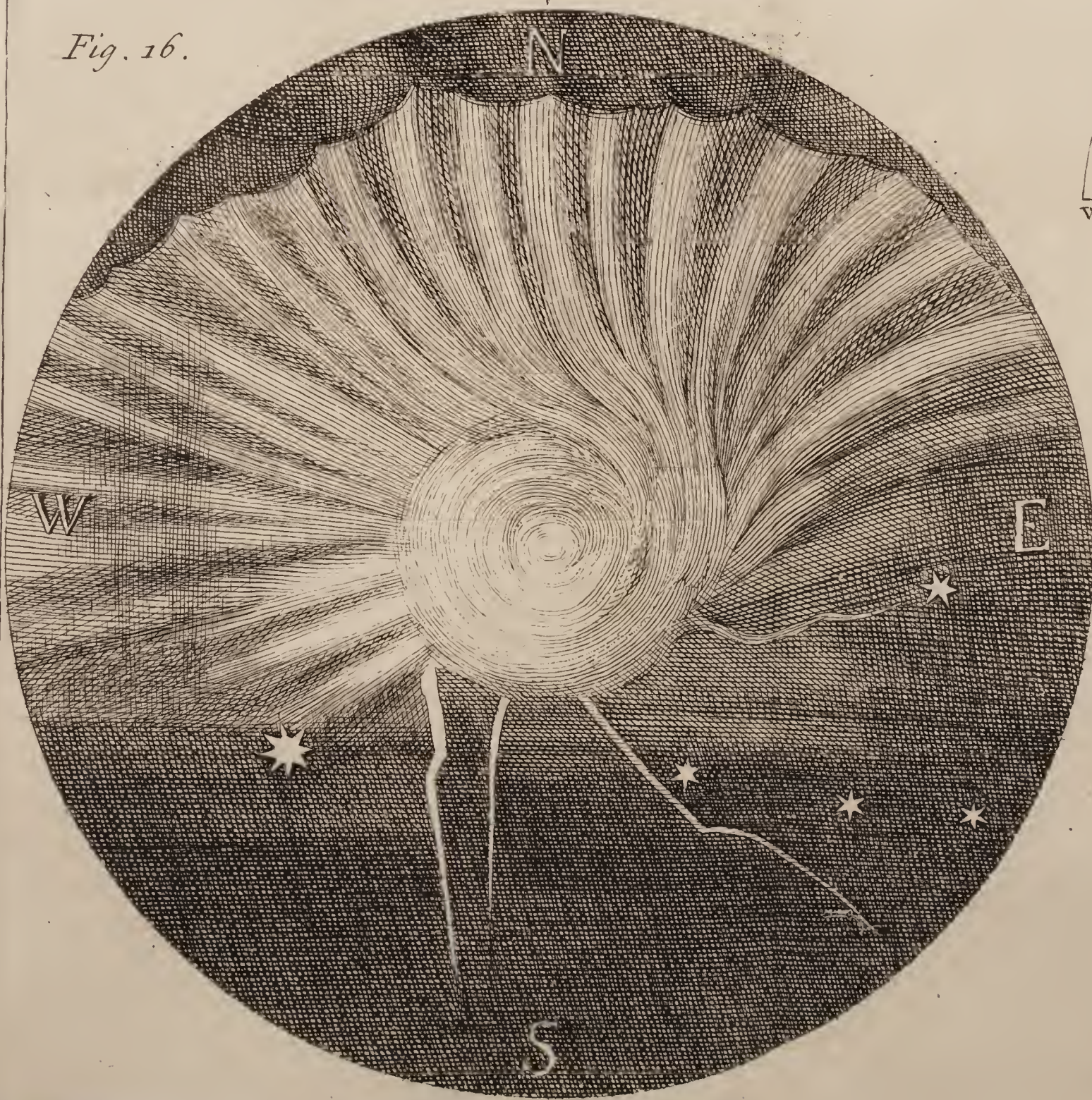


Fig. 16.










Water a long while, and is afterwards, in hot Weather, very apt to break into large Cracks and Fissures; whereas on the contrary, those Soils in the Mountains, where they observe the small Fires, are what they call soft, or *sweet Ground* (*terreni dolci*) being generally sandy, and of a more loose Contexture, which do not keep the Water so long as the others. Of that Sort, also is the Soil in the above-mentioned Plains of *Barisella*, where, about seven or eight Years since, they observed a good Number of the smallest *Ignes Fatui* in the Fields, within the Compass of about three Miles. One Thing I will beg Leave to add, that according to the best Informations I have hitherto been able to procure, these Lights are great Friends to Brooks and Rivers, being frequently observed along the Banks of them, perhaps because the Air carries them thither more easily than any where else. In all other Particulars, as in their Motion, the Manner of their Appearance, their disappearing sometimes very suddenly, their Light, the Height they rise to, and their not being effected either by rainy or cold Weather, they are the very same with the *Cularsi* above described, or the large *Will with a Whisp*, as observed in the Plains.

I intended here to have closed this Account, but I cannot forbear adding the following Observation, which in my Opinion is very curious and singular. I am indebted for it to a young Gentleman, a very accurate and knowing Observer of natural Appearances. Travelling some time in *March* last, between eight and nine in the Evening, in a mountainous Road not far from our Lady *del Sarso*, about ten Miles South of *Bologna*, as he approached a certain River called *Rioverde*, he perceived a Light, which shone very strongly upon some Stones that lay upon the Banks. It seemed to be about two Foot above the Stones, and not far from the Water of the River: In Figure and Largeness it had the Appearance of a *Parallelopiped*, somewhat above a *Bolognese* Foot in Length, and about half a Foot high, it's longest Side lying parallel to the Horizon: It's Light was very strong, infomuch that he could very plainly distinguish by it Part of a neighbouring Hedge, and the Water in the River; only in the East Corner of it the Light was pretty faint, and the square Figure less perfect, as if cut off, or darkened by the Segment of a Circle. The Gentleman's Curiosity tempted him to examine it a little nearer; in order to which he advanced gently towards the Place, but was surprized to find, that insensibly it changed from a bright Red to a yellowish, and then to a pale Colour, in Proportion as he drew nearer, and that when he came to the Place itself, it was quite vanished. Upon this he stepped back, and not only saw it again, but found that the farther he went from it, the stronger and brighter it grew; nor could he upon narrowly viewing the Place where this fiery Appearance was, perceive the least Blackness, or Smell, or any Mark of an actual Fire. The same Observation was confirmed to me by another



another Gentleman, who frequently travels that Way, and who assured me, that he had seen the very same Light five or six different Times, in *Spring* and *Autumn*, and that he had always observed it in the very same Shape and the same Place, which to me seems very difficult to be accounted for. He told me farther, that once he took particular Notice of it's coming out of a neighbouring Place, and then settling itself into the Figure above described. How it comes to pass, that the nearer one approaches to these, or the like fiery Appearances, the fainter they grow, till at last they disappear totally, I very freely own my self at a Loss, but yet I cannot help thinking, that there is something in it analogous to what we observe in Fogs and Clouds, which at a Distance have indeed the Appearance of very thick Bodies, but are found more rare as one gets into them. Nor is it improbable, as they must be something very thin and subtle, that upon the Approach of grosser Bodies with their Atmospheres, they are actually driven away.

This is the Substance of what I have been able to gather from several Accounts relating to the *Ignes Fatui*; but as to the Causes of them I will not pretend to assign any: I will only add, that all that ever saw any of these fiery Appearances agree, and you may assure Mr *Derham* of it, that they cast a Light quite different from that of the *shining Flies*; and if you please to reflect on the several Circumstances above related, I believe you will find, that they are not easily, if at all, to be solved by that Hypothesis. I intend in another Letter to trouble you with some Questions, and likewise some Observations of my own on *these Flies*.



BAROMETRUM.



## BAROMETRUM.

## THERMOM.

## HYGROMETRUM.

Hic pono *Pondus* Athmosphæræ incumbētis, in planum pedis quadrati *Rhenolandici*, cujus Athmos. pondus 1947 libras Amstelædamenses pendet, quando  $\varphi$  in barometro altitudo est 27 *poll.* 7 *lin.* pendet 2094 lb. Amst. quando altitudo fuit  $\varphi$  in barometro 29 *poll.* 8 *lin.* hæc enim fuit maxima & minima  $\varphi$  in barometro observata altitudo intra plures jam annos.

Hic calorem Athmosphæræ in loco observationis designavi ex rarefcente Aëre ita ut summum frigus observatum sit ubi notabatur gradus 1000, aqua pura gelasceret ad grad. 1070, ebulliret vero ad grad. 1510.

Mensuravi hic aquæ copiam in Athmosphærâ in loco observationis; juxta accrescens decrescive pondus spongiæ ad bilancem appensæ, quam spongiam prius Muria Salis Ammoniaci humectaveram.

Quantitas aquæ, quæ totius hujus anni decursu mense quolibet exhalaverat, in Aëre aperto, & ventis perflato. *Rhenoburgi.*

## XLII.

*Observations on the middle Height of the Barometer, the middle Elevation of the Thermometer, the middle Variation of the Hygrometer, the quantity of Rain, Dew, Snow, and Hail, the quantity of Water that has exhaled, the Height of the Water in a Well, out of which none was drawn for a whole Year, and the monthly Variation of a Watch, by Nicholas Cruquius, F. R. S. No. 381. pag. 4.*

	lb.	grad.		pond.	lin.
Januar. —	2051	1076	—	81	7
Februar. —	46	85	—	80	14
Martio —	35	102	—	80	33
Aprili —	46	109	—	60	36
Maio —	57	126	—	57	58
Junio —	53	140	—	57	57
Julio —	2044	129	—	58	37
Augusto —	46	141	—	60	39
Septemb. —	54	132	—	61	24
Octobri —	55	121	—	71	15
Novemb. —	53	104	—	77	15
Decemb. —	35	96	—	79	12
Summa 575		1361	—	821	347
12			—		
Medium 2048		1113	—	68	
					toto anno.
					28 <i>pol.</i> 11 <i>lin.</i>



Aquæ Cœlo delapsæ,  
nimirum

Pluviæ, Roris,  
Nivis, Grandinisque  
Altitudo ;

Cum cauta curâ, ne ex-  
halatione, aut alio mo-  
do vel minimum pe-  
rierit.

Aquæ altitudo  
putealis, in pu-  
teo, mensurata  
a summo ejus  
margine, ad a-  
quæ superficiem,  
in fine cu-  
jusque mensis.  
Fuit vero putei  
profunditas ima  
usque ad fabu-  
lum scaturiens  
vel currens, ni-  
hilque aquæ in-  
de eductum to-  
to observationis  
tempore.

Observatio accelerati,  
vel retardati Cursus, in  
Horologio portatili ac-  
curatissimo.

Ut pateat  
quot minuta, in quo-  
que Mense, plura vel  
pauciora, absolverit.  
Hic (+) augmenti,  
(÷) decrementi nota  
est.

Ratio relata ad Solis  
decursum.

<i>Delphis.</i> <i>lin. dec.</i>	<i>Rhenoburgi.</i> <i>lin. dec.</i>	<i>ped. pol.</i>	<i>Minuta.</i>
— 17.9	— 21.2	— 5 : 4	— + 151 Jan.
— 25.1	— 23.8	— 4 : 11	— + 21 Febr.
— 18.8	— 28.-	— 5 : 7	— ÷ 168 Mar.
— 5.5	— 7.5	— 6 : 10	— ÷ 120 Apr.
— 4.2	— 2.7	— 8 : 1	— ÷ 123 Maio.
— 3.2	— 4.8	— 9 : 3	— ÷ 130 Jun.
— 38.6	— 28.-	— 9 : 7	— ÷ 90 Jul.
— 41.9	— 40.2	— 9 : 7	— + 133 Aug.
— 15.1	— 14.8	— 9 : 9	— + 24 Sept.
— 8.2	— 11.3	— 9 : 8	— + 19 Oct.
— 30.7	— 29.7	— 9 : 3	— + 266 Nov.
— 30.6	— 40.-	— 8 : 2	— + 252 Dec.
<hr/> 239.8	<hr/> 252	<hr/> 96 : —	<hr/> +866, & ÷ 631
<i>poll. 20 (in toto anno) 21 poll.</i>		<i>Med. 8 ped.</i>	<i>five + 235</i>
			<i>in quoque mens. 20' accelerat.</i>



Observationes per aliquot annos factæ.

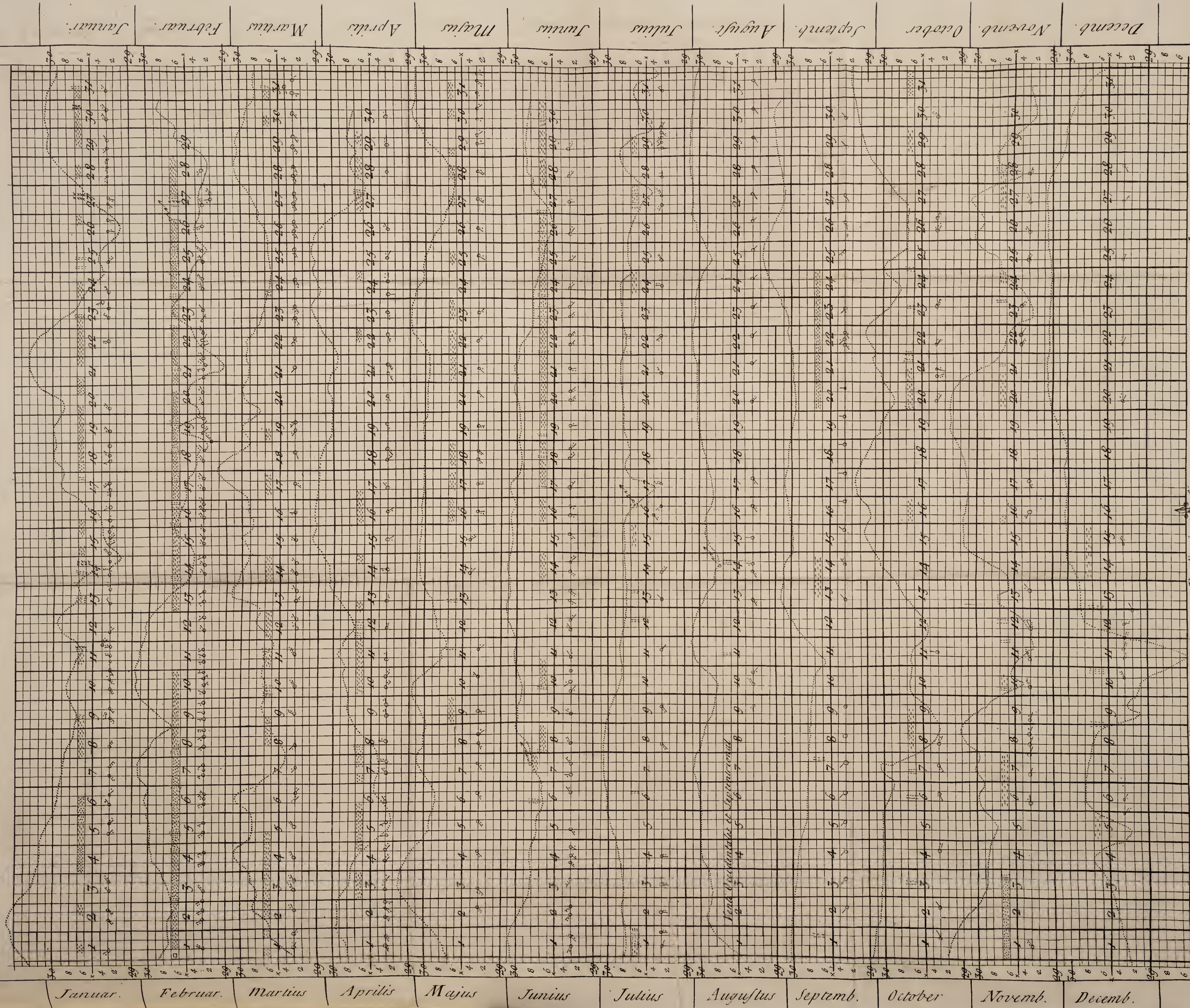
Ann. Jan. Feb. Martio.	Ap. Mai. Jun. Jul. Aug. Sept.	Oct. Nov. Dec.	Sum. Med. Ann. 12 lb.
1720 2034 34 38	36 38 42 45 36 50	40 38 23	454 2038 1720
1721 52 42 36	29 29 43 51 46 43	42 32 29	474 39 1721
1722 76 41 32	41 42 45 36 39 50	59 37 30	528 44 1722
1723 51 46 35	46 57 53 44 46 54	55 53 35	575 48 1723
213 163 141	152 166 183 176 167 197	196 160 117	169
2053 41 35	38 41 46 44 42 49	49 40 29	2042
grad.	THERMOMETERUM.		Grad.
1720 1087 89 86	102 126 126 145 138 121	107 91 91	1308 109 1720
1721 90 74 75	112 116 137 136 142 133	110 100 84	1308 109 1721
1722 79 90 97	109 122 134 139 140 135	117 101 90	1353 113 1722
1723 76 85 102	109 126 140 129 141 132	121 104 96	1361 113 1723
332 338 360	432 490 537 549 561 521	455 396 361	444
83 85 90	108 122 134 137 140 130	114 99 90	111
pond.	HYGROMETERUM.		pond.
1721 89 82 73	80 69 64 63 68 76	76 89 88	917 76 1721
1722 88 85 76	63 62 62 63 68 70	76 81 88	882 74 1722
1723 81 80 80	60 57 57 58 60 61	71 77 79	821 69 1723
258 247 229	203 188 183 184 196 207	223 247 255	219
86 82 76	68 63 61 61 65 69	74 82 85	73
lineæ.	Pluvia, &c. Delphis.		pell. lin.
1715 11 20 36	8 15 18 95 62 36	37 47 15	400 33:4 1715
1716 19 20 14	7 17 4 48 19 55	57 21 32	313 26:1 1716
1717 31 15 29	29 31 28 29 28 24	32 29 28	333 27:9 1717
1718 21 18 6	30 17 17 35 27 14	46 21 25	277 23:1 1718
1719 33 20 10	11 17 4 12 34 23	25 24 22	235 19:7 1719
1720 36 24 21	21 15 20 23 55 47	56 25 20	363 30:3 1720
1721 20 31 27	59 30 34 15 41 27	57 30 48	419 34:11 1721
1722 2 20 25	23 15 22 49 53 25	7 21 53	315 26:3 1722
1723 18 25 19	5 4 3 39 42 15	8 31 31	240 20: 1723
191 193 187	193 161 150 345 361 266	325 249 274	241:3
21 21 21	21 18 17 38 40 30	36 28 30	26:10



lin.				Pluvia &c. Rhenoburgi				pol. lin.	
1720	35	16	13	24	29	14	54	367	30:7 1720
1721	21	29	28	59	35	28	27	417	34:9 1721
1722	3	20	27	29	28	27	26	376	31:4 1722
1723	21	24	28	7	3	5	15	282	21: 1723
80 89 96				119 95 74	122 109 122	122 122 122	122 122 122	117:8	
20 22 24				30 24 19	30 50 30	30 30 43		29:5	
lin.				Aqua quæ exhalavit Rhenoburgi.				pol. lin.	
1720	10	10	10	25	44	55	50	371	30:11 1720
1721	8	9	15	54	47	60	27	362	30: 2 1721
1722	5	7	20	28	54	54	34	366	30: 6 1722
1723	7	14	33	36	58	57	24	347	28:11 1723
30 40 78				143 203 226	209 196 135			120:6	
8 10 20				36 51 56	52 49 34	20 15 12		30:2	
ped. pol.				Putealis Aquæ Altitudo.				ped. pol.	
1720	6:	6:	3 6: 5	6: 7 6: 6 8:	8:11 9: 8:3	6:11 5:8 5:5		84:	7: 1720
1721	5:6	5:6	4: 6	4: 2 5: 7 7:	8: 1 7: 9 7:7	6: 3 4:6 4:4		70:9	5:11 1721
1722	6:	5:7	5:11	6: 1 6:10 7:11	8: 7:10 7:4	7: 9 7:3 4:6		81:	6: 9 1722
1723	5:4	4:11	5: 7	6:10 8: 1 9: 3	9: 7 9: 7 9:9	9: 8 9:3 8:2		96:	8: 1723
22:10 22:3 22:5				23:8 27: 32: 2	34:7 34: 32:11	30:7 26:8 22:5		27:8	
5:8 5:7 5:7				5:11 6: 9 8:	8:8 8:6 8:3	7:8 6:8 5:7		6:11	
Minuta				Horologii portatilis Curfus.					
1722	÷ 34 ÷ 9 ÷ 7			÷ 5 ÷ 38 ÷ 55	÷ 89 ÷ 78 ÷ 84	÷ 8 ÷ 151 ÷ 246		18: ÷ 402	1722
1723	÷ 131 ÷ 1 ÷ 187			÷ 139 ÷ 142 ÷ 149	÷ 109 ÷ 113 ÷ 4	÷ 1 ÷ 246 ÷ 232		18: ÷ 727	1723
87 ÷ 8 ÷ 194				÷ 134 ÷ 180 ÷ 204	÷ 198 ÷ 35 ÷ 80	÷ 9 ÷ 397 ÷ 478		18: ÷ 1129	
48 ÷ 4 ÷ 97				÷ 67 ÷ 90 ÷ 102	÷ 99 ÷ 17 ÷ 40	÷ 4 ÷ 199 ÷ 239		18: ÷ 564	
Jan. Feb. Mar.				Apr. Maii. Jun.				Jul. Aug. Sept.	
								Oct. Nov. Dec.	



*Tabula praecepue Altitudinem fere Singulis Horis BAROMETRI, totius Anni decursu 1723 Sylo Veteri digitis Londinensib; ut et pro parte Pluvias; Plagas, Violentiasque Ventorum; nec non Coeli faciem, Lugduni Observata exhibens.*



Altitudo Barometri. Velum. Vires Ventorum. Pluvia. Nix. Grando. Nebula. Tentru. Coelum Nubibus Obductum.







XLIII. I took three pound of *Mercury*, which by measure filled three times a small glass Jar exactly full, and poured it into a thin Florence Flask: then having poured the same quantity of Water (that is, three of the same Jars full) into another such Flask, I set both the Flasks in a Pail, and poured boiling Water about them, keeping the Flask that had the Water down by Force that it might be as low in the hot Water as the *Mercury*. After the Fluids in the Flasks had received a sufficient degree of Heat from the Water, which was round the Flasks, for the Space of five Minutes, I took the Flasks out of the hot Water, and putting that which held the Water into a Cylicindric Vessel, that had three Pints of cold Water in it, I did at the same time plunge the Flask with *Mercury* into another Cylicindric Vessel containing also three pints of cold Water, and observed which of the cold Waters was most heated in the following manner.

*An Experiment made before the R. Society, June 30, 1720, to prove that Bodies of the same Bulk do not contain equal quantities of Matter, and therefore that there is an interspersed Vacuum, by the Rev. J. T. Desaguliers F. R. S. N<sup>o</sup>. 365, p. 81.*

A little Thermometer being held in the first Vessel of cold Water, so as to have it's Ball covered with the Waters, upon the putting in the Flask of warm Water, the spirit rose two degrees; then putting the Thermometer into the Water where the Flask that had the *Mercury* was, the Spirit rose three degrees higher. The Thermometer being again put into the first Vessel fell four degrees, and afterwards again into the last it arose almost three degrees.

This shews that more heat is communicated by warm *Mercury* than by an equal Bulk of Water equally warmed; and therefore that there is more Matter in the *Mercury*; but how much more Matter there is in the *Mercury* is not determined by this Experiment alone.

N. B. The warm *Mercury* and the warm Water were not poured into the cold; but only communicated their Heat through the Flasks.

XLIV. 1. The incomparable Sir *Isaac Newton* has not only shortened the Geometrician's Work, by his wonderful Discoveries in abstract Mathematics; but has also taught us, by his own Practice, how to make, and judge of, Experiments and Observations with the utmost Accuracy: And as he avoided making Hypotheses; he was so cautious as to deliver only by way of Queries, several Truths which he was convinced of; because he wanted a sufficient Number of Experiments to make them as evident as those others, whereby he has so far improved and advanced Natural Knowledge. Our Author has followed his steps, asserting nothing but what is evidently deduced from those Experiments, which he has carefully made, and faithfully related; given an exact Account of the Weights, Measures, Powers and Velocities, and other Circumstances of the Things he observed; with so plain a Description of his Apparatus, and manner of making every Experiment and Observation, that as his Consequences are justly and easily drawn, so his Premises or Facts may be judged.

*An Account of a Book entitled Vegetableness: Or an Account of some Statical Experiments on the Sap in Vegetables; being an Essay towards a Natural History of Vegetation. Also, a Specimen of an Attempt to analyse the Air, by a great Variety of Chymico-Statical Experiments.*



periments; which were read at several Meetings before the Royal Society, &c. By Stephen Hales, B. D. F. R. S. &c. *The Account by the Rev. J. T. Desaguliers, LL.D. R. S. S. No. 398. pag. 264. and No. 399. pag. 323.*

judged of by any Body that will be at the Pains to make Experiments, which are most of them very easy and simple.

His Account of every Thing is written in such an intelligible manner, that the inquisitive Reader is capable of understanding it, without being puzzled with perplexed Calculations and complex Experiments; which Authors have sometimes contrived, in order to be admired for those Things, which they themselves found out either by mere chance, or with very little Labour. He has illustrated, and put past all Doubt, several Truths mentioned in Sir *Isaac Newton's* Queries; which though believed by some of our Eminent Philosophers, were called in question by others of an inferior Class, who were not acquainted with those Facts and Experiments upon which Sir *Isaac Newton* had built those Queries.

Chap. I. *Experiments, shewing the Quantity of Moisture imbibed and perspired by Plants and Trees.*

II. *Experiments whereby to find the Force with which Trees imbibe Moisture.*

III. *Experiments, shewing the Force of the Rise of the Sap in the Vine, in the Bleeding Season.*

IV. *Experiments, shewing the ready lateral Motion of the Sap, and consequently the lateral Communication of the Sap-Vessels: The free Passage of it from the small Branches towards the Stem, as well as from the Stem to the Branches. With an Account of some Experiments relating to the Circulation, or Non-Circulation of the Sap.*

V. *Experiments, whereby to prove, that a great Quantity of Air is inspired by Plants.*

VI. *A Specimen of an Attempt to analyze the Air, by a great Variety of Chymio-Statical Experiments, which shew, in how great a proportion Air is wrought into the Composition of Animal, Vegetable, and Mineral Substances; and withal how readily it resumes it's former elastic State, when in the Dissolution of those Substances it is disengaged from them.*

VII. *Of Vegetation.* Our Author in this Chapter applies his several Experiments, and Conclusions drawn from them, to Vegetation; and shews chiefly the following Things, viz. That Vegetables are composed of Sulphur, volatile Salt, Water, Earth and Air.

That in Nutrition, the Sum of the attracting Powers of those Substances is superior to the Sum of the repellent; and as the watery Vehicle flies off, the Parts harden.

That Oil, which is made up of Sulphur and Air, abounds in Seeds for their better preservation.

That in cold Countries, where those Principles are not so firmly united, small Wines, such as *Rhenish*, most easily yield their Tartar (which by Experiments appears to contain Oil and Air;) but gene-



rous Wines, such as *Madera*, having those Principles more firmly united, will bear a great degree of Heat before they part with them.

That the use of the Leaves of Trees is to bring up Nourishment within reach of the Attraction of the Fruit, to carry off the redundant watery Fluid; to imbibe Rains and Dews which are impregnated with Salt and Sulphur; as likewise to imbibe Air, and to be of the same use to Plants as the Lungs are to Animals.

That Plants which are overshaded, or too replete with Moisture, cannot so well imbibe Air: Therefore, though they will shoot out fast, and have much Wood, they will be more barren in proportion.

Mr *Hales*, by a very ingenious Contrivance, found the Degrees of growing in every part of young Shoots, which in their growing extend themselves most in the middle, and least towards the top and the bottom; the ductile Matter for their growth being drawn out in length like melted Glass-Tubes, which retain a Hollowness, though drawn out to the smallest Thread. N.B. *In some Animals there is such a tough ductile Substance, which hardens when exposed to the Air in small Threads, as in Spiders and Silk-Worms.*

He shews, that the Pith serves to supply the dilating Moisture for the tender Shoots, but that their Figure may be oblong, and not round, as the Fruit commonly is, there are tough Diaphragms in the Pith at small distance from each other, which check the lateral Expansion; as also horizontal Fibres, which serve for the same purpose: And of the same sort is the Pith in the large growing Feathers of Birds; which is made up of Vesicles that can be distended lengthwise, but have Sphincters at the ends, to prevent too large a lateral Dilatation. ——— That the Bones of Animals do not grow at the Joints (which would prevent their free Motions) but at the *Symphysis*, viz. where the Heads join to the Shanks of the Bones.

———— That there are particular Vessels in Vegetables, as well as Animals, appropriated for conveying different sorts of Nutriment; and that where a viscid Substance is to be furnished, the Vessels are lengthened, and often fetch a compass to retard the Velocity of the Fluid, which is to be inspissated into an hard Substance. Thus in hard Stone-Fruits the Umbilical Vessel goes round the Concave of the Stone, and then enters the Kernel near it's Cone.

At last, our Author traces the Vegetation of a Plant, from a Seed to a Tree again producing Seed; for which Account, as it cannot well be contracted, we must refer to the Author's own Words.

2. The Author, after dedicating his Tracts to the Royal Society, gives a Description of the particular Sort of Barometer, Thermometer, Hygrometer, and Hyetometer, which he made use of in the subsequent Observations. The first of these is a Diary of the Weather, from the Vernal Equinox of the Year 1728, to that of the Year 1729; containing the daily State of the Barometer, Thermometer,

*An Account of a Book entituled, J. Frieder. Weidleri Observationes Meteorologicae.*

Wind



& Astronomica, Annotum 1728 & 1729, 6<sup>to</sup>. Wittembergæ, Anno 1729. No. 412. pag. 250.

*An Account of a Book entituled Observationes Meteorologicae.*

Wind and Weather, together with the Quantity of Rain during that Time. To this he annexes some select Meteorological and Astronomical Observations, which he describes more at large.

The first he takes Notice of is a remarkable *Halo* round the Moon, on *February* 20, 1728, at forty-five Minutes past Seven in the Evening, when the Moon was not far distant from the Meridian, and about her first Quarter. The Diameter of the *Halo* occupied about 47 Degrees, being extended from  $\epsilon$  in *Procyon* to *Capella* towards the West. It's Arch was  $4\frac{1}{2}$  Deg. broad, as far, for Instance, as  $\alpha$  and  $\epsilon$  in *Procyon* are from each other. Within it was red, and towards the Extremity was pale; exhibiting entire a beautiful Spectacle for about four Minutes, but he did not know when it began. Before it dispersed, some thin white Clouds began to pass over it transversely, and then it was broke towards the West, the Redness of the dispersing Vapours greatly encreasing: After which the Sky became clear again. The same Day at Noon, he observed thirteen Spots on the Sun, the largest equalling  $\frac{3}{4}$  of the Sun's Diameter; and the Spirit fell to 90 Degrees of the *English* Thermometer.

*April* 4, 1728, he observed an *Aurora Borealis*.

On *June* 20, another, which is described in the *Act. Erudit. Lips. Ann.* 1728. p. 375.

*October* 7, a very remarkable one appeared in the N. E. A *White Arch*, extended between the W. and N. E. quickly assumed a black Colour, and then divided into three other concentrical Arches equally black. From these some Radiations arose as usual, but shorter. A little afterwards these likewise ceased and the black Arches were converted into luminous Tracts, only one remained till eleven o'Clock: And whereas at first the lowermost Arch was raised seven Degrees above the Horizon, it was now depressed towards it, being scarcely two Degrees above it.

The Author next proceeds, and gives fourteen Astronomical Observations, ten of which are of the Eclipses of *Jupiter's* Satellites at different Times. In making these he was guided by *Cassini's* Tables for the Meridian of *Paris*, and by comparing the Time when they should happen, as therein specified, with the Time he observed them at *Wittemberg*, he collects the Difference of Meridians of that City and *Paris* to be 41 Minutes.

The eighth Observation contains his *Calculus* for the total Eclipse of the Moon which happened *February* 13, 1729, N. S. but the Heavens being very cloudy, he could not observe the Eclipse itself.

The ninth is an Observation of *Mercury*, *March* 4, 1729; at which Time the Planet was farthest from the Sun, and remained some Time above the Horizon. Making use therefore of a twenty-two Foot Telescope, he observed it's Phase almost bisected, and it's Diameter appeared equal to a third part of the Diameter of *Venus*, this Planet being above the Horizon, and seen at the same Time.



The thirteenth is a Conjunction of *Venus* and the Moon, viz. *April* 2, 1729. At 7<sup>h</sup>. 13' he observed *Venus* placed in such manner near the Moon, that the Horns of the Moon were in the same right Line with *Venus*, which was then distant from the Southern Cusp of the Moon 1 Deg. 10'. At 7<sup>h</sup>. 30'. he measured the Distance of *Venus* from the Eastern Cusp of the *Pleiades* to be 2 Deg. 15', and the Horn of the Moon at the same Time was distant from the same Cusp 1 Deg. 53', 45''; the intermediate Distance of the Horns of the Moon was 29' 30''.

His last Observation is on the Declination of the Magnetical Needle in this and the former Year, which he defines to be 12 Deg. 0' 55'' West at *Wittemberg*, at this Time.

These Observations are followed by the Author's Account of the last hard Winter, This set in sooner than usual, the Rivers being frozen the 19th of *September*, though they used not to be so till the Winter Solstice, and the Spirit of Wine in the *English* Thermometer, on *September* 21, fell to the 66th Degree: At which Time a N. E. Wind blew very strong. Afterwards, on *October* 3, the Spirit fell to 72 Deg. and the Ice was half an Inch thick on standing Waters in the Fields, so that even then it might be judged, that the Cold would be more severe than is usual in their Parts. From this Time the Frost did not at all abate, but continued much in the same State the Month of *October*, except on the 20th Day, after a S. W. Wind had blowed pretty hard for some Days, the Cold was observed to encrease remarkably. The Beginning of *November* a strong East Wind continuing to blow for six Days, the Spirit sunk to 86 Deg. on the 5th, and the Ice was much thicker. On the 28th it fell to 96 Deg. after which they had no Rain, but all Vapours were congealed into Ice and Hoar. On *December* the 2d, the Spirit of Wine stood at 96 Deg. but on the 4th at 99 Deg. so that it not a little exceeded the Limit of intense Cold. Hence a S. W. Wind intervening now and then, the Cold seemed to abate a little; but that, and sometimes a N. E. Wind blowing stronger on the 21st, 22d, and 23d Days, it so prepared the Air, that on *Christmas* Day the Spirit in the Thermometer stood at 96 Deg. and the Cold was intense. Hence the Winter grew immediately more severe. The Wind almost always blew from the E. or N. so that on *January* 20, the Cold was almost intolerable, on which Day the Spirit descended to the 126th Deg. very little remaining above the Ball of the Tube; and this was the greatest Degree of Cold at *Wittemberg*. After this the Winter somewhat declined. A S. W. Wind blew fresh sometimes; but afterwards a N. and E. Wind restored the Cold on *February* 3, when the Spirit stood again at 86 Deg. On the 4th it fell to 95 Deg. and from this Time, barring a few Days, always in a Morning it reciprocated between 80 Deg. and 100 Deg. to *March* the 8th, on which it exceeded 106 Deg. and on the 9th it was forced down by a



N. E. Wind to 110 Deg. But although the Spring was at Hand, yet the Severity of the Weather did not cease, as appears in that the Spirit of Wine, in the *English* Thermometer, in a Morning always stood at, or under the 80th Deg. of the Thermoscopic Scale; nay, even on *March* the 21st, on which Day the Equinox precisely fell, it was at 81 Deg. At length, on the last Day of *March*, the Weather grew milder, from whence may be taken the true Beginning of the Spring; not but that all *April* was much colder than usual.

Thus far from Thermoscopical Observations. After this, the curious Observer proceeds to shew it's Severity from some of the more remarkable Effects the Cold had on the Rivers, Plants, and Animals. As to the first, he says, that the *Elbe*, both at *Wittemberg* and other Places, was covered on *December* 29, with a perfect Bridge of Ice, which bore both Men and all Sorts of Carriages. This remained till *February* 28, when it grew thinner, and broke considerably; but the Cold returning on *March* 8, it re-united, and was as firm as before, till *March* 29. The Water within the Houses, and in the Bed-chambers, where were good Fires, was wholly congealed and the Rind within on the Windows stuck for many Days, when the Wind was either E. or N. though the Room was well warmed. Examples of the other Kinds were several. Many Persons perished in their Journeys, and more lost their Limbs in a very short Time: So that near the *Elbe* they could not work abroad. It killed also many Animals immediately. The Crows, which can bear intense Cold, fell dead from the Trees: Stags, Goats, and Hares, perished in great Numbers. The Plants likewise felt it's Violence, and the more tender Trees were damaged. The Limes were every where injured: The greater Branches of the Plumb-trees, Apricocks, and Peaches, were dried up; but the Vines suffered most, the more robust being shriveled to the very lowest part of their Trunk, unless guarded by a Wall, or some other Covering.

From these Observations the Author compares this Winter with the memorable one of 1709, and proves both from Thermoscopical Observations; from it's Effects upon the Earth and Animals; from it's longer Continuance; and from the greater Extent of the Cold into the more Southern Parts, that this last much exceeded the former, at least in *Germany*.

Having thus finished the History, he lastly enquires into the probable Causes of it. He takes Notice, that the Winter foregoing was moderately cold and dry; and as a cold Summer succeeded, and alike dry, in which the North Winds blew most frequently, and during the hottest Months of *July* and *August* the Sky was covered with dark and black Clouds, the Earth was prepared for Frost; to which the remarkable Driness of the Season did not contribute a little, as Barometrical Experiments shew, that a dry Air cools sooner than a moist, and is both heavier, and retains Cold longer.



Neither does he think it altogether foreign to Truth, to reckon the remarkable Frequency of the *Aurora Borealis* to be a Prefage of a colder Winter than ordinary, which has been observed to be followed by cool and serene Weather: As also the unusual Number and Largeness of the Spots on the Sun's Disk, for almost two Years together; by which Means, in such a Length of Time, the Force of it's Rays might be obstructed in some Degree, and the colder Winds thereby have Liberty to prevail. The Air by these concurrent Causes being rendered very cold, the Encrease, and extreme Degree of it proceeded from the great Cloudiness of the Sky; and the blowing of the N. E. or E. Wind so remarkably observable for the most part of the Frost.

---

## CHAP. II.

# HYDROLOGY.

I. **T**Here have been several Machines contrived for measuring the different Depths of the Sea, especially such as could not be determined by the Lead and Line; but as those Machines consisted of two Bodies (the one specifically lighter, and the other specifically heavier than Water) so joined together, that as soon as the heavy one came to the Bottom, the lighter should get loose from it, and emerge; and the Depth was to be estimated by the Time of the Fall of the compound Body from the Top to the Bottom of the Water, together with the Time of the Emerfion of the lighter Body, reckoned from the disappearing of the Machine, till the emergent Body was seen again, no certain Consequence could be drawn from so precarious and complex an Experiment.

For even in still Water, and in the same Place, the Time will hardly be the same in two Experiments: Much less will this Machine answer in the Sea, on Account of Waves and Currents, and many other Hindrances.

But as the Pressure of Fluids in all Directions is always the same at the same Depth, a Gage which exactly discovers what the Pressure is at the Bottom of the Sea, will shew what is the true Depth of the Sea in that Place, whether the Time of the Descent of the Machine be but a Minute or two, or twenty Times as long.

The Reverend Mr Hales, in his *Vegetable Statics*, describes his Gage for estimating the Pressure made in opaque Vessels; where Honey being poured over the Surface of Mercury in an open Vessel, rises upon the Surface of the Mercury as it is pressed up into a Tube

*An Account of a Machine for measuring any Depth in the Sea, with great Expedition and Certainty; shew'd to the Royal Society, by J. T. Desaguliers, L. L. D. and R. S. S. contrived by the Rev. Mr Stephen Hales, F. R. S. and Himself. No. 405. pag. 559.*



whose lower Orifice is immersed into the Honey and Mercury, and whose Top is hermetically sealed. Now as, by the Pressure, the Air in the Tube is condensed, and the Mercury rises, so the Mercury comes down again when the Pressure is taken off, and would leave no Mark of the Height to which it had risen; but the Honey (or Treacle, which does better) which is upon the Mercury, sticking to the Inside of the Tube, leaves a Mark, which shews the Height to which the Mercury had risen, and consequently makes appear what was the greatest Pressure.

Fig. 26.

My Contrivance therefore is a Machine which will carry down Mr Hales's Gage to the Bottom of the Sea, and immediately bring it up again.

A B, is the Gage Bottle.

F f, the Gage Tube cemented to the Brass Cap of the Bottle at G, with it's open End f immersed in the Mercury C, which by the Pressure of 32 Foot of Water is carried up to d with a little Treacle or Honey d upon it, raised up from D, a small Thickness of Treacle poured on upon the Mercury.

When the Pressure of Water is from a Depth of 64 Foot, the Mercury and Treacle rise up to E,  $\frac{2}{3}$  of the Height of the Tube; and so higher proportionably to the Depth.

N. B. *A Scale may be marked on the Tube with a Diamond.*

K, is a Weight hanging by it's Shank L. in a Socket m, fixed to the Ring M B cemented at the Bottom of the Bottle. When the Hole L of the Shank is shoved up to m, the Catch l of the Spring S holds it from falling out of the Socket, whilst the Machine is descending. But as soon as K touches the Ground at the Bottom of the Sea, the Hole L rising, the Catch flies back and lets go the Weight, as it is seen in the Figure. Then the empty Glass Ball I (which at Sea may be a Hog's Bladder) rises up to the Surface of the Water with the Machine, in which observing how high the Inside of the Tube is daubed, the Pressure, and consequently the Depth of the Sea, is known.

HG, is a Brass Tube to guard the Top of the Gage Tube.

There are Holes at F, G and E, to admit the Water to pass freely every where.

To confirm the Use of this Sea-Gage, shewn before to the Society, I made another Experiment in the following Manner. Having poured some Quicksilver into the Bottle of the Gage, I poured upon it Treacle to the Depth of half an Inch, then screwed on the Brass Cap of the Bottle to which the Glass Gage-Tube was cemented; by which Means the open End of the Tube was brought under the Surface of the Mercury, the sealed End being upwards. The Machine, thus fitted, was immersed in a cylindric Vessel of Water, which with a Plate at Top was pressed between two Pillars, in such Manner that Air might be condensed over the Water without escaping



ping. Then having forced in so much Air with a Syringe, as to lay on a Pressure equal to what would be in a Depth of 40 Foot of Water, I opened the Cock of the upper Plate, let out the Air, and, upon taking out the Machine, it appeared how high the Quicksilver had risen in the Gage-Tube, by the greasy Mark which the Treacle left within.

II. *Hero Alexandrinus*, and other Hydraulic Writers, have described a Cup (called a *Tantalus*, from it's Effect) which will hold any Liquor very well; when it is not filled above a certain Height marked in the Cup; but if it be filled higher, not only the Liquor above the Mark will run out, but the whole Liquor that was in the Cup. This is performed by a Syphon in the Cup, which is sometimes concealed to make the Effect the more surprizing.

The Cup, A B (*Fig. 27.*) has a visible Syphon C E D in it; the Cup, (*Fig. 28.*) has the same, concealed by the Figure of a Man, to represent *Tantalus* in the Fable; and the Cup of (*Fig. 29.*) has it's Syphon more concealed, as it is carried up into the Handle. Any of these Cups will hold Water very well, provided they are not filled up above the Line F G; for then not only the Liquor that is above F G will run out, but all the Liquor in the Cup as low as D, the Orifice of the short Leg of the Syphon.

*Experim. I.] (Fig. 30.)* In the Vessel *a b c d* is placed an open wooden Box A B C D filled with Water as high as the Line L M Another Box or Plug E F G H made tight, and containing Weights to sink it, is made to let down into the Water between the Partition I K and the End A B of the Box above mentioned; but when it is not to press the Water up to I O, (as it does when let down) it is drawn out of the Water by the Weight *m*, which pulls it up by the Bar *ik* fastened to a Leaver moving round the Center *l*.

When, by means of the Plug, the Water in the Space A B K I is pushed up to I O, by passing under K; it runs out thro' the Spout P Q (whose Passage is gaged by a little Sluce P *p*) and falls into the Vessel R S made of an oblong Figure like a Fish-Pond, and having a Syphon at S, so as to make it a *Tantalus*, or in the Nature of the Cups above-mentioned.

Let the Weight *m* pull up the Plug E F G H, and the Water, having filled R S, will run down below the Orifice P to M.

The *Tantalus* R S, beginning to run out as soon as full, will for the Reasons above given, continue to run till it is all emptied; and as it discharges itself into another *Tantalus* T V (whose Syphon is at V); this last *Tantalus* will also, when full, begin to run out, and it's Water go down to *x Y o*.

If the Plug be let down gradually, as soon as the Water begins to run out of the last *Tantalus* T V, (and the first *Tantalus* R S be covered so as to be concealed from Sight) it will appear to the Lookers on, That the Cavity T V, representing a Pond near an ebbing and

*An Attempt to account for the rising and falling of the Water of some Ponds near the Sea, or ebbing and flowing Rivers; where the Water is lowest in the Pond, at the Time of high Water in the Sea or River; and highest in the Pond, at the Time of low Water in the Sea or River. As also for the increasing or decreasing of the Water of such Pools and Brooks as are highest in the dry Seasons, and lowest in the rainy Seasons: With an Experiment to illustrate the Solution of the Phænomena. By the Rev. J. T. Desaguliers, L. L. D. and R. S. S. No. 384. p. 132.*



flowing River (as I am credibly informed there is such an one at *Greenhithe* in *Kent*, between *London* and *Gravesend*) always rises, whilst the Water at NO (or the Tide) falls to LM; and always sinks whilst the Water at LM (or the Tide) rises to OL.

Experim. II.

Let the Water in the Box ABCD not be made use of; only the Vessel Z be filled every half Hour: It will empty itself in the Space of a Quarter of an Hour, falling like Rain, and dropping also thro' the Leaden Platform *ef* into the hidden *Tantalus* RS, which will not begin to run till this artificial Rain is over: Then in a Quarter of an Hour more, the *Tantalus* RS will have emptied it self into the visible *Tantalus* TV, which will be filling all the Time after Z has done running; (or in the dry Season) and as soon as TV is full, it will begin to run out thro' it's Syphon V, at the End of the half Hour, when the Vessel Z or Sieve runs again; that is, at the Return of the rainy Season.

This last Experiment may easily be applied to those Ponds, or those Brooks, that are high in dry Weather, and low in wet Weather; of which Kind, I am told, there is a Brook at *Lambourn* in *Berkshire*.

If it be objected, that such Ponds are full for some time, which a *Tantalus* cannot be, because it begins to run out as soon as full; that may be easily solved, by supposing the hidden *Tantalus*, (or intermediate Cavity between the River and Pond) to contain more Water than the visible one, provided it does not contain so much as not to be emptied, before the Return of the Tide.

The same Solution will serve for wet and dry Seasons, only supposing the Cavities larger.

If it be asked, where the Water of the visible *Tantalus*, near a River, can run; it may be answered, that all this may happen, tho' the second, or lowest *Tantalus* should have it's Bottom higher than low Water-Mark in the River. And for the Syphons, which are of a particular Make in the Cup; tho' such be not supposed in the Earth, yet any long Passage, rising in the Middle, will answer the End. A B C D represents the Channel of a River, A D high Water-Mark, and G H low Water-Mark; Z I a Passage from the River to the Cavity I K L M N, or first, or hidden *Tantalus*; L M Q the Syphon of the first *Tantalus*, running into the second *Tantalus*, or visible Pond O Q R P, which by it's Syphon R S V runs out into low Grounds that may be above the low Water-Mark G H; and the Bottom K L of the first *Tantalus* may be above the Top of the last, whose Level is the Line W W.

Fig. 31.

A B C D Y O Q R P V H is the Section of the Surface of the Earth.



Fig. 23.

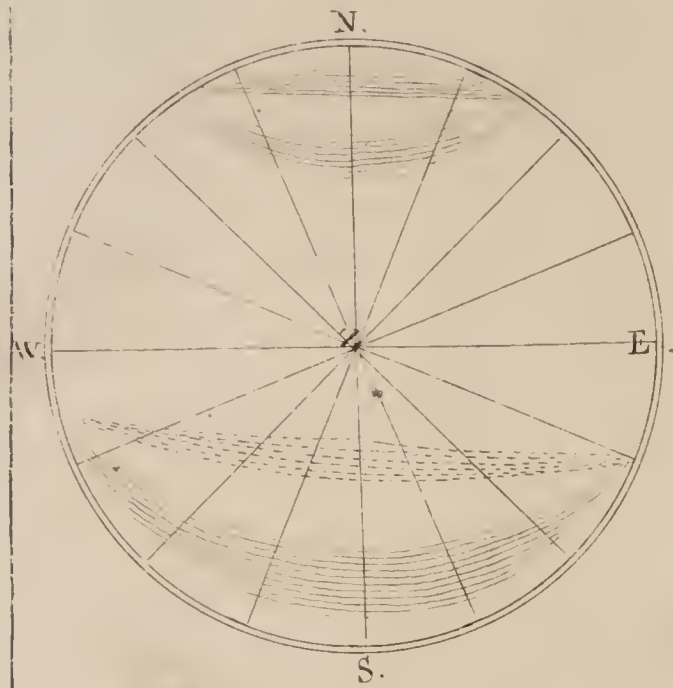


Fig. 24.

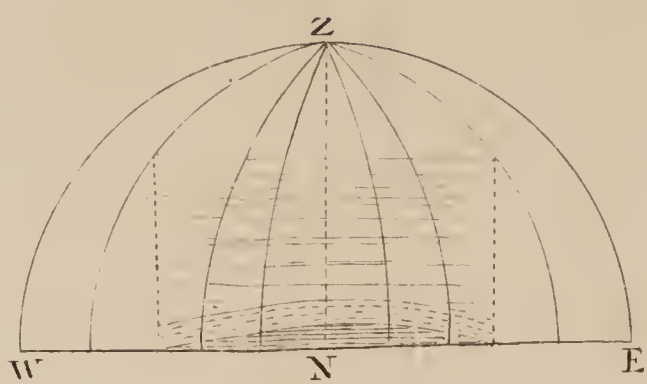


Fig. 25.

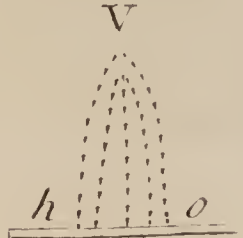


Fig. 27.

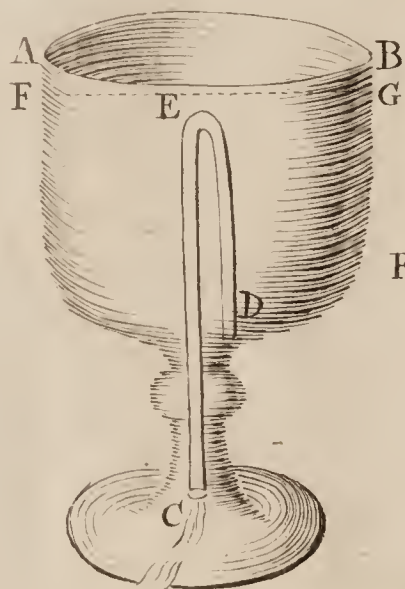


Fig. 29.



Fig. 28.

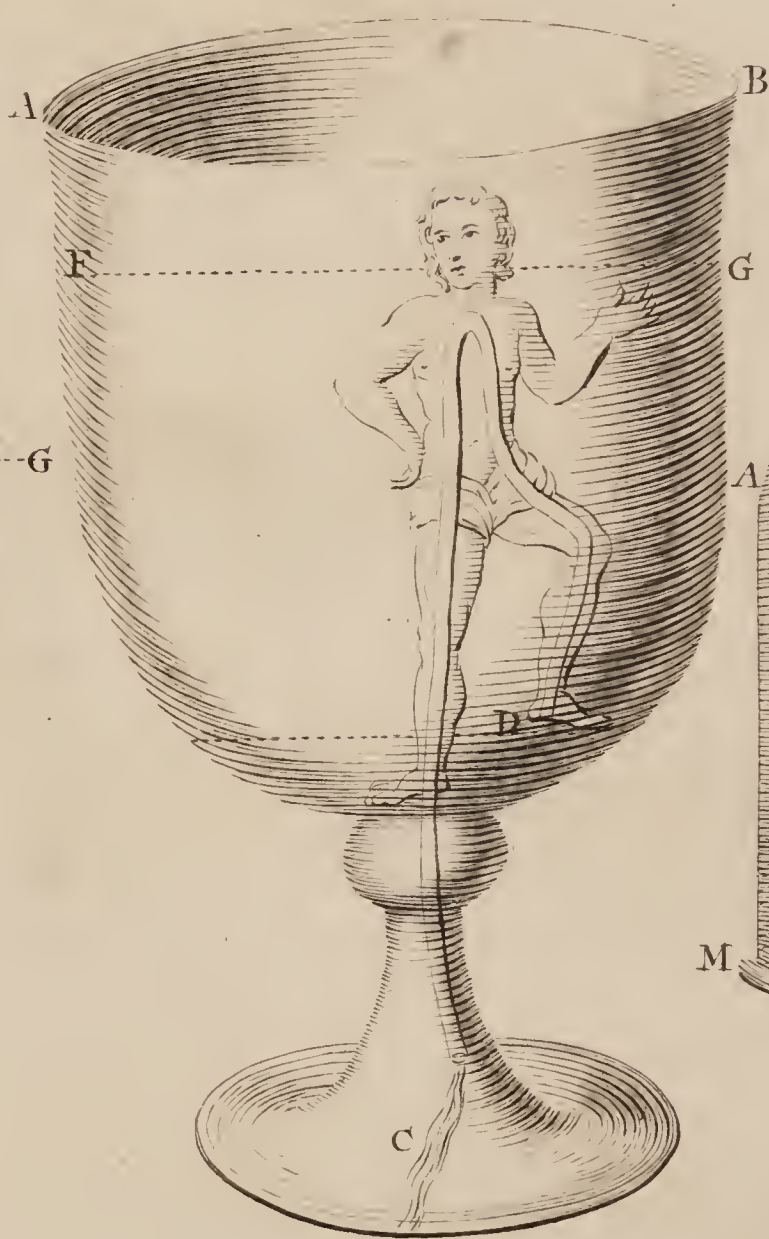
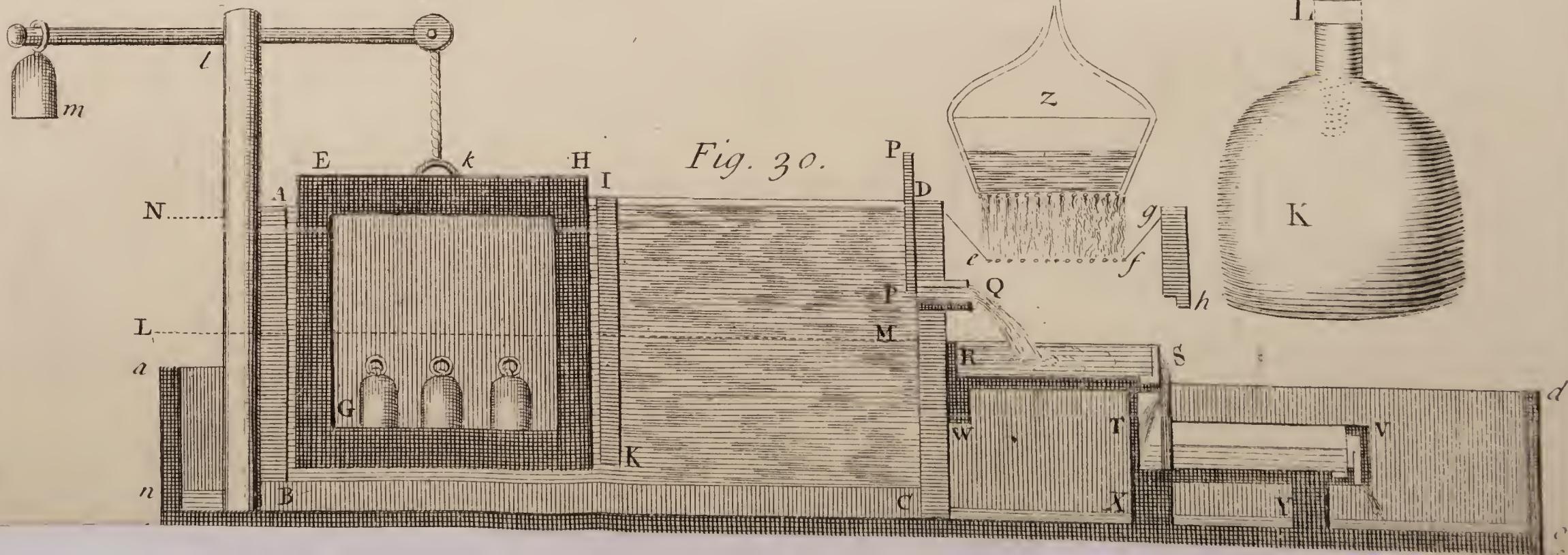
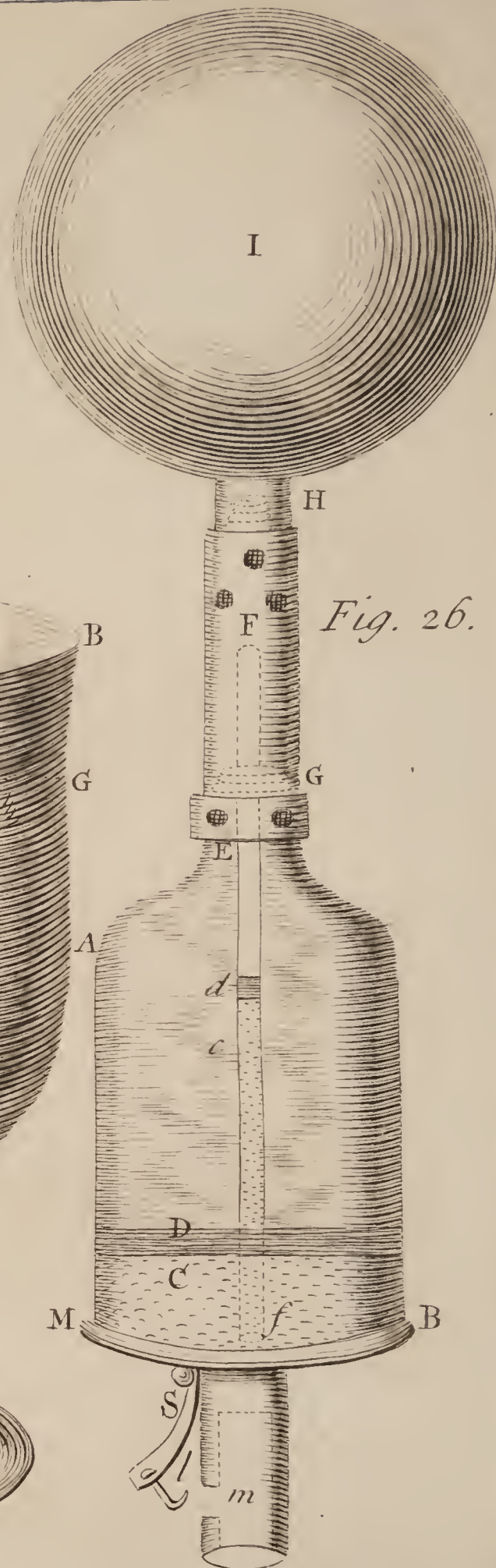


Fig. 26.





Printed



III. *March* the 8th, 1725-6, The *Tide* in the *River Thames*, at *New Crane* in *Shadwell*, flowed twenty Foot, five Inches and a half, taken by a Level, from that High-water Mark, to Low-water the next Morning, and was four Inches higher than has been known these forty Years.

*An Extraordinary high Tide in the River Thames observed by Capt. Tho. Jones. No. 393. p. 68.*

IV. That the Use of my Instrument called the \* *Marine Surveyor* may yet farther appear, I shall here give some Experiments I made with it on the *River Thames*, in order to determine the Strength of the Tides of *Flood* and *Ebb*. Were the same to be done in the Channel, and on the Sea Coast of *Great Britain*, and marked in our Charts, I am humbly of Opinion, it would be of no small advantage to our Commerce, and of consequence a sufficient Recommendation of the *Marine Surveyor*, if that alone were the Use of it.

*Observations upon the Tides in the River Thames, by Mr Henry de Saumarez. No. 393. pag. 68.*

I am induced the rather to be of this Opinion, in regard I am not insensible of the Dangers on the *Casquets*, in the *Race* of *Alderney*, &c. where rapid Tides and Currents have occasioned but too many to mourn the Loss of Friends and Fortunes: As I dwell in the Neighbourhood of these Dangers, I have (in manifest hazard of my Life) surveyed and taken correct Draughts not only of them, but of the Islands of *Guernsey*, *Sarck*, &c. And as I persuade my self they are as correct, as any thing that has hitherto appeared of this kind, it is my intent to publish them for the Good of the Public.

\* *Vid. Philos. Transact. No. 391.*

A T A B U L A R



*A TABULAR Account, shewing the Strength and gradual Increase and Decrease of the Tides of Flood and Ebb in the River Thames, as observed in Lambeth Reach, off of Manchester Stairs, and in the Middle of the River, with a new Instrument called the Marine Surveyor, on the 9th of June, 1720; It being then Full Moon, and consequently a Spring Tide. The Movement of the Machine 14 Inches under Water.*

F L O O D.									
The Time of Flood.		The Depth of the River.		The Run of the Current in every 15 Min.	The whole Run of the Current to the Times expressed in the first Column.	The same reduced to Statute Miles of 5280 Feet, or 528 Revolutions of the Machine.		The Reduction into English maritime Miles of 6000 feet, or 600 Revolutions.	
H.	M.	Feet	Inch.	Feet.	Feet.	M.	Pts	Rev.	M. Pts. Rev.
	15	5		110	110			11	11
	30	6		590	700			70	70
	45	6	9	1100	1800			48	30
1		7		1400	3290		$\frac{1}{4}$	55	$\frac{1}{2}$ 29
1	15	8		1870	5160		$\frac{3}{4}$	120	$\frac{3}{4}$ 66
	30	9		2230	7390	1	$\frac{1}{4}$	79	1 139
	45	10		2500	9890	1	$\frac{3}{4}$	65	1 $\frac{1}{2}$ 89
2		11	6	2660	12550	2	$\frac{1}{4}$	67	2 55
2	15	13		2730	15280	2	$\frac{3}{4}$	76	2 $\frac{1}{2}$ 28
	30	14		2740	18020	3	$\frac{1}{4}$	86	3 2
	45	14	9	2720	20740	3	$\frac{3}{4}$	94	3 $\frac{1}{4}$ 124
3		14	9	2570	23310	4	$\frac{1}{4}$	87	3 $\frac{3}{4}$ 81
3	15	14	10	2220	25530	4	$\frac{3}{4}$	45	4 $\frac{1}{4}$ 3
	30	14	9	1820	27350	5		66	4 $\frac{1}{2}$ 35
	45	14		.990	28340	5	$\frac{1}{4}$	62	4 $\frac{1}{2}$ 134
	50	13	9	.130	28470	5	$\frac{1}{4}$	75	4 $\frac{1}{2}$ 147



E B B.									
The time of Ebb.	The Depth of the River.		The Run of the Current in every 15 Min.	The whole Run of the Current to the Times expressed in the first Column.	The same reduced to Statute Miles of 5280 feet, or 528 Revolutions of the Machine.		The Reduction into English maritime Miles of 6000 feet, or 600 Revolutions.		
H. M.	Ft.	In.	Feet.	Feet.	M. Pts	Rev.	M.	Pts	Rev.
15	12	9	280	280		28			28
30	12	3	1140	1420	$\frac{1}{4}$	10			142
45	11	10	1900	3320	$\frac{1}{2}$	68	$\frac{1}{2}$		32
1	11	4	2080	5400		12	$\frac{3}{4}$		90
1 15	11	2	2120	7520	1	$\frac{1}{4}$	1	$\frac{1}{4}$	2
30	10	9	2120	9640	1	$\frac{3}{4}$	1	$\frac{1}{2}$	64
45	10	4	2170	11810	2		1	$\frac{3}{4}$	131
2	10		2130	13940	2	$\frac{1}{2}$	2	$\frac{1}{4}$	44
2 15	9	6	2060	16000	3		2	$\frac{1}{2}$	100
30	9	4	2040	18040	3	$\frac{1}{4}$	3		4
45	9		2020	20060	3	$\frac{3}{4}$	3	$\frac{1}{4}$	56
3	8	9	1910	21970	4		3	$\frac{1}{2}$	97
3 15	8	6	1900	23870	4	2	3	$\frac{1}{4}$	137
30	8	3	1910	25780	4	$\frac{3}{4}$	4	$\frac{1}{4}$	28
45	8		1860	27640	5		4	$\frac{1}{2}$	64
4	7	9	1810	29450	5	$\frac{1}{2}$	4	$\frac{3}{4}$	95
4 15	7	3	1780	31230	5	$\frac{3}{4}$	5		123
30	7		1690	32920	6		5	$\frac{1}{4}$	142
45	6	6	1620	34540	6	$\frac{1}{2}$	5	$\frac{3}{4}$	4
5	6	3	1570	36110	6	$\frac{3}{4}$	6		11
5 15	6	3	1570	37680	7		6	$\frac{1}{4}$	18
30	6		1570	39250	7	$\frac{1}{4}$	6	$\frac{1}{2}$	25
45	6		1560	40810	7	$\frac{1}{2}$	6	$\frac{3}{4}$	31
6	5	9	1550	42360	8		7		36
6 15	5	6	1500	43860	8	$\frac{1}{4}$	7	$\frac{1}{4}$	36
30	5	3	1460	45320	8	$\frac{1}{2}$	7	$\frac{1}{2}$	32
45	5		1450	46770	8	$\frac{3}{4}$	7	$\frac{3}{4}$	27
7	4	9	1430	48200	9		8		20
7 15	4	6	1400	49600	9	$\frac{1}{4}$	8	$\frac{1}{4}$	10
30	4	3	1380	50980	9	$\frac{1}{2}$	8	$\frac{1}{4}$	148
45	4	3	1340	52320	9	$\frac{3}{4}$	8	$\frac{1}{2}$	232
8	4		1270	53590	10		8	$\frac{3}{4}$	109
8 5	3	10	420	54010	10		9		1
10	3	11	410	54420	10	$\frac{1}{4}$	9		42
15	4		400	54820	10	$\frac{1}{4}$	9		82
20	4		380	55200	10	$\frac{1}{4}$	9		120
25	4	2	300	55500	10	$\frac{1}{2}$	9	$\frac{1}{4}$	
30	4	2	270	55770	10	$\frac{1}{2}$	9	$\frac{1}{4}$	27
35	4	3	130	55900	10	$\frac{1}{2}$	9	$\frac{1}{4}$	40
40			Stagnt.	Stagnant.					



*A TABULAR Account, shewing the Strength and gradual Increase of the Tides of Flood and Ebb in the River Thames, as observed in Lambeth Reach, off of Manchester Stairs, and in the Middle of the River, with a new Instrument called the Marine Surveyor, on the 18th of June, 1720; It being then the last Quarter of the Moon, and consequently a Neap Tide. The Movement of the Machine 14 Inches under Water.*

F L O O D.											
The Time of Flood.		The Depth of the River.		The Run of the Current in every 15 Min.	The whole Run of the Current to the Times expressed in the first Column.	The same reduced to Statute Miles of 5280 feet, or 528 Revolutions of the Machine.	The Reduction into English maritime Miles of 6000 feet, or 600 Revolutions.				
							M.	Pts	Rev.	M.	Pts
	15	4		220	220			22			22
	30	4	3	520	740			74			74
	45	4	9	900	1640	$\frac{1}{4}$		32	$\frac{1}{4}$		14
1		5	3	1030	2670	$\frac{1}{2}$		3	$\frac{1}{2}$		117
1	15	5	9	1020	3690	$\frac{1}{2}$		105	$\frac{1}{2}$		69
	30	6	1	1160	4850	$\frac{3}{4}$		89	$\frac{3}{4}$		35
	45	7		1450	6300	1		102	1		30
2		7	9	1640	7940	1	$\frac{1}{2}$	2	1		44
2	15	8	1	1830	9770	1	$\frac{3}{4}$	53	1	$\frac{1}{2}$	77
	30	9		1920	11690	2		113	1	$\frac{3}{4}$	119
	45	9	6	2070	13760	2	$\frac{1}{2}$	56	2	$\frac{1}{4}$	26
3		10		2170	15930	3		9	2	$\frac{1}{2}$	
3	15	10	4	2070	18000	3	$\frac{1}{4}$	84	3	$\frac{1}{4}$	
	30	11	3	1960	19960	3	$\frac{3}{4}$	16	3	$\frac{1}{4}$	46
	45	11	4	1890	21850	4		73	3	$\frac{1}{2}$	85
4		11	9	1700	23550	4	$\frac{1}{4}$	111	3	$\frac{3}{4}$	105
4	15	11	6	1300	24850	4	$\frac{1}{2}$	109	4		85
	30	11		730	25580	4	$\frac{3}{4}$	50	4	$\frac{1}{4}$	8
	35	11		70	25650	4	$\frac{3}{4}$	57	4	$\frac{1}{4}$	15
	40			Stagnt.	Stagnt.						
	45	10	10	dit.	dit.						
	50	10	9	dit.	dit.						



E B B.											
The Time of Ebb.		The Depth of the River.		The Run of the Current in every 15 Min.	The whole Run of the Current to the Times expressed in the first Column.	The same reduced to Statute Miles of 5280 feet, or 528 Revolutions of the Machine.		The Reduction into English maritime Miles of 6000 feet, or 600 Revolutions.			
H	M.	Ft.	In.	Feet.	Feet.	M.	Pts	Rev.	M.	Pts	Rev.
	15	10	6	610	610			61			61
	30	10		1340	1950		$\frac{1}{4}$	63		$\frac{1}{4}$	45
	45	9	9	1520	3470		$\frac{1}{2}$	83		$\frac{1}{2}$	47
1		9	3	1650	5120		$\frac{3}{4}$	116		$\frac{3}{4}$	62
1	15	9		1750	6870	1	$\frac{1}{4}$	27	1		87
	30	8	6	1730	8600	1	$\frac{1}{2}$	68	1	$\frac{1}{4}$	110
	45	8		1700	10300	1	$\frac{3}{4}$	106	1	$\frac{1}{2}$	130
2		7	9	1710	12010	2	$\frac{1}{4}$	13	2		1
2	15	7	3	1710	13720	2	$\frac{1}{2}$	52	2	$\frac{1}{4}$	22
	30	7	1	1710	15430	2	$\frac{3}{4}$	91	2	$\frac{1}{2}$	45
	45	6	9	1710	17140	3		130	2	$\frac{3}{4}$	64
3		6	7	1680	18820	3	$\frac{1}{2}$	34	3		82
3	15	6	4	1670	20490	3	$\frac{3}{4}$	69	3	$\frac{1}{4}$	99
	30	6		1570	22060	4		94	3	$\frac{1}{2}$	106
	45	5	9	1500	23560	4	$\frac{1}{4}$	112	3	$\frac{3}{4}$	106
4		5	8	1480	25040	4	$\frac{1}{2}$	128	4		104
4	15	5	3	1440	26480	5		8	4	$\frac{1}{4}$	98
	30	5	2	1430	27910	5	$\frac{1}{4}$	19	4	$\frac{1}{2}$	91
	45	5		1420	29330	5	$\frac{1}{2}$	29	4	$\frac{3}{4}$	83
5		5		1430	30760	5	$\frac{3}{4}$	40	5		76
5	15	4	10	1420	32180	6		50	5	$\frac{1}{4}$	68
	30	4	6	1430	33610	6	$\frac{1}{4}$	61	5	$\frac{1}{2}$	61
	45	4	4	1420	35030	6	$\frac{1}{2}$	71	5	$\frac{3}{4}$	53
6		4	1	1380	35410	6	$\frac{3}{4}$	77	6		41
6	15	3	11	1360	37770	7		81	6	$\frac{1}{4}$	27
	30	3	11	1340	39110	7	$\frac{1}{4}$	83	6	$\frac{1}{2}$	11
	45	3	10	1230	40340	7	$\frac{1}{2}$	74	6	$\frac{1}{2}$	134
7		3	10	1070	41410	7	$\frac{3}{4}$	49	6	$\frac{3}{4}$	91
7	15	3	11	530	41940	7	$\frac{3}{4}$	102	6	$\frac{3}{4}$	144
	20	4		20	41960	7	$\frac{3}{4}$	104	6	$\frac{3}{4}$	146
	25			Stagnt.	Stagnt.						
	35	4	3	dit.							

Of the Currents at the Straights Mouth. By Capt - - - Communicated by Dr. Hudson. No. 385. pag. 191.

V. Cape Spartel, and Cape Trafalgar, from the western Ocean, are known to make the Straights Mouth, from whence a Current, in the middle of the Channel (which is about five Leagues broad) betwixt the Barbary and Spanish Land, runs, at least, two Miles each Hour, as far as Ceuta Point; and there the two Coasts opening about



eighteen Leagues distant from each other, the Current does not run above one Mile an Hour, and so continues as far as Cape *de Gat*, which is seventy Leagues up the *Mediterranean*. Our Mariners observe a Current to set to the western Sea, or the great Ocean from *Ceuta*, along the *Barbary* Shore; and from *Gibraltar* along the *Spanish* Shore; but that on the *Barbary* Shore is generally their common Rout, not only as being the freest from Rocks and less dangerous, but by reason that the Tide is much stronger, than it is on the other Side, which the sooner helps the Ships out of the *Streights*, which are the narrowest betwixt the Points of *Gibraltar* and *Ceuta*; at which last Place, a Neck of Land extends itself a considerable Way into the Sea; and it's my Opinion, and that of others, that whereas the Current runs, as abovesaid, two Miles an Hour against this Neck of Land, the Water there meets with so violent an Opposition in it's Course, as occasions it to rebound with so much Force, that Part of it returns back along the same Coast, and so out of the *Streights* Mouth; which, with the small Tide that sets out on the *Spanish* Shore, 'tis believed, may exhaust a considerable Part of that Current, which continually sets in, to the Eastward, at the Rate I have already mentioned. What I look upon to be very remarkable, is that in the Year 1712, Monsieur *du L'Aigle*, that fortunate and generous Commander of the Privateer called the *Phœnix* of *Marseilles*, giving Chase, near *Ceuta* Point, to a Dutch Ship bound for *Holland*, he came up with her in the middle of the Gut, or *Streights*, betwixt *Tariffa* and *Tangier*, and there gave her one Broad-side, which directly sunk her, all her Men being saved by the Means of Mons. *du L'Aigle*; and a few Days after, the sunk Ship, with her Cargo of Brandy and Oil, arose on the Shore near *Tangier*, which is, at least, four Leagues to the Westward of the Place where she sunk, and directly against the Strength of the Current; which has persuaded many Men, that there is a Recurrency in the deep Water in the middle of the Gut, that sets outwards to the grand Ocean, which, I think, this Accident very much demonstrates; and possibly, a great Part of the Water, which runs into the *Streights*, does return that Way, and along the two Coasts which I have already mentioned; otherwise, this Ship of Course, must have been drove towards *Ceuta*, and so upwards. I was at *Gibraltar* when this happened, where I saw above 100 of the Butts of that Cargo of Brandy, which were sent thither from *Tangier*; I likewise spoke with the Captain of the Dutch Ship, who told the Governor, myself, and many others, where his Vessel sunk; and her rising afterwards at *Tangier*, appeared very unaccountable to us, as it does to me to this Day; for there's no Doubt but the Ship sunk where the Dutchman told us, since the *Spaniards* from the Land, who saw it, confirmed it to us. The Water in the Gut must be very deep, several of the Commanders of our Ships of War having attempted to sound it with the longest Lines they could contrive, but could never find any Bottom.



VI. The Falls of *Niagara* are a mighty Ledge or Precipice of solid Rock, that lies across the whole breadth of the River (a little before it empties it self into or forms the Lake *Ontario*) and very steep.

Monsieur *Borassaw* never measured the Falls himself, though he has been there at seven different Times: But what he says is, That,

This last Spring the Governour of *Canada*, Monsieur *Vaudreil*, ordered his own Son, with three other Officers, viz. Messieurs *Longue Isle*, *St Ville*, and *Laubineau*, to survey *Niagara*, and take the exact height of the Cataract, which they accordingly did with a Stone of half an hundred Weight, and a large Cod-line, and found it upon a Perpendicular no more than twenty six Fathom; his Words were *Vingt & Six Bras*.

*An Account of the Falls of the River Niagara taken at Albany, Octob. 10. 1721. from Monsieur Borassaw, a French Native of Canada. By the Hon. Paul Dudley, Esq; F. R. S. N<sup>o</sup>. 37<sup>e</sup>. pag. 69.*

This differs very much from the Account Father *Hennepin* has given the World of that Cataract, for he makes it an hundred Fathom; and our Modern Maps from him, as I suppose, mark it at six hundred Feet; but I believe *Hennepin* never measured it, and there is no guessing at such Things.

When I objected *Hennepin's* Account of those Falls, to Monsieur *Borassaw*, he replied; That accordingly every Body had depended upon it as right until the late Survey. Upon further Discourse he acknowledged, That below the Cataract for a great way, there were numbers of small Ledges, or Stairs cross the River, that lowered it still more and more, till you come to a Level; so that if all the Descents be put together, he does not know but the Difference of the Water above the Falls, and the Level below, may come up to Father *Hennepin*, but the strict and proper Cataract upon a perpendicular, is no more than twenty six Fathom, or an hundred and fifty six Foot, which yet is a prodigious Thing, and what the World I suppose cannot parallel, considering the greatness of the River, for it is near a Quarter of an *English* Mile broad, and very deep Water.

Several other Things Monsieur *Borassaw* set me right in, as to the Falls of *Niagara*. Particularly it has been said, That the Cataract makes such a prodigious noise, that People cannot hear one another speak, at some Miles distance whereas he affirms, you may converse together close by.

I have also heard it positively asserted, That the Shoot of the River when it comes to the Precipice, was with such a mighty force, that Men and Horse might march under the Body of the River without being wet. This also he utterly denies, and says the Water falls in a manner right down. What he observed farther to me was,

That the Mist or Shower (his Word was *La Brume*) which the Falls make, is so extraordinary, as to be seen at five Leagues distance, and rises as high as the common Clouds. In this *Brume* or Cloud, when the Sun shines, you have always a glorious Rainbow.

Of



Of the River it self, which is there called the River *Niagara*, he tells me it is much narrower at the Falls, than either above or below, and that from below there is no coming nearer the Falls by Water, than about six *English* Miles, the Torrent is so rapid, and withal such terrible Whirl-pools.

He confirms Father *Hennepin's* and Mr *Kellug's* Account of the large Trouts of those Lakes, and solemnly affirmed there was one taken lately, that weighed eighty six Pounds ; which I am the rather inclined to believe upon the general Rule that Fish are according to their Waters. To confirm which, a very worthy Minister, now alive in *New England*, affirmed to me ; That while he was a Prisoner at *Mon-real*, in *Canada* River, he saw a Pike brought up one Day from the River to the Governour's House, and carried upon a Pole between two Men, that measured Five Foot, and Ten Inches long, and proportionably large.

I my self this last Summer, saw a Cataract, three Leagues above *Albana*, in the Province of *New York*, upon *Schenechtada* River called the *Coboes*, which they count much of there ; and yet that is not above 40 or 50 Foot perpendicular. From these Falls also there rises a misty Cloud, which descends like small Rain, that when the Sun shines, gives a handsome small Rainbow that moves as you move, according to the Angle of Vision. The River at the *Coboes* is to 40 or 50 Rods broad, but then it is very shallow Water, for I was told that in a dry Time, the whole River runs in a Channel of not more than fifteen Foot wide.

In my Journey to *Albany*, 20 Miles to the Eastward of *Hudson's* River, near the middle of a long rising Hill, I met with a brisk noisy Brook sufficient to serve a Water-Mill, and having observed nothing of it at the beginning of the Hill, I turned about and followed the Course of the Brook, till at length I found it come to an End, being absorbed, and sinking into the Ground, either passing through Subterraneous Passages, or soaked up with the Sand ; and though it be common in other Parts of the World for Brooks and even Rivers thus to be lost ; yet this is the first of the Sort, I have heard of, or met with in this Country.

*An Account of the Rise of several of the most considerable Rivers in Europe, by J.G. Scheuchzer, M. D. F. R. S. No. 406. p. 587.*

*The Rhosne.*

VII. The *Rhosne*, *Rhodanus*, by *Marcellinus* called, *maximi nominis flumen*, and by *Varro*, *Fluvius inter tres Europæ maximus*, arises from two *Gletchers*, as we call them, or *Montes glaciales*, huge Mountains of Ice, near the *Furca*, whose Height hath been above determined, and thence runs with great Impetuosity down *Vallesia*, the *Wallisserland*, forming a long Valley, surrounded on both Sides with huge Mountains, till it loses it's Waters and Name in the *Lacus Lemannus*, or *Lake of Geneva*, but resumes it again near the Town of *Geneva*, whence it flows with a more gentle Descent through some Provinces of *France* into the *Mediterranean Sea*.

The



The *Theſin*, *Ticinus*, by *Claudian*, in his Panegyric upon the Conſulat of the Emperor *Honorius*, called *Pulcher*, the handſom, takes it's firſt Riſe from two ſmall Lakes upon the *S. Gothard*, and ſome lateral Sources from the *Lago ſopra la Cima di Pettine*, upon a Mountain called *Pettine*, the *Lago della Sella*, the Lake of *Rottom* upon the *Luckmannier Berg*, the Lake of *Tom*, and the Lake of *Bedretto*, upon a Mountain of this Name. It deſcends the *Lavinia Vallis*, or *Liviner Valley*, and in it's way to the Lake of *Locarno*, receives many Brooks and Rivulets from the adjoining Mountains: It unites it's Waters with the *Po*, near *Pavia*, and loſes itſelf jointly with that River into the *Adriatic Gulf*.

The *Rhine*, *Rhenus*, by *Cæſar de Bello Gallico* termed, *latiſſimus atque altiſſimus*, ariſes in three ſeveral Branches, which are called *Rhenus anterior*, *poſterior*, & *medius*, the further, the hinder, and middle *Rhine*. The hinder *Rhine* takes it's Riſe upon the high Mountain *Avicula*, *Colmen del Ocello*, Part of the *Adula*, in the Alp *San Porta*, from a *Gletcher*, or Ice-Mountain, which extends in Length full two Hours. The middle *Rhine*, *Rhenus medius*, ariſes upon the *Luckmannier Berg*, which is likewiſe Part of the *Adula*, in the upper Part of a Valley, called *San Maria*, oppoſite to one of the Sources of the *Theſin*. The furthermoſt *Rhine*, *Rhenus anterior*, ariſes upon that Branch of the *Criſpalt*, which is called *Cima del Badut*, *Badùz*, and ſoon receives ſeveral lateral Branches from the *Alps Mugels* and *Cornera*. Near the Monastery of *Diſcentis*, the further and middle *Rhine* join together, and the united Stream falls into the hinder *Rhine*, near *Reichenau*. Below *Rheineck*, the *Rhine* falls into the *Lacus Bodamicus*, or *Boden Sea*, and comes out of it near *Stein*; whence waſhing for ſome time the Borders of *Swiſſerland*, it then traverses great Part of *Germany* in a very irregular Courſe, till at laſt, in *Holland*, it loſes itſelf in the great Ocean.

The *Reiſs*, *Rufa*, ariſes from a ſmall Lake called *Lago di Luzen-dro*, upon the *S. Gothard*, but ſoon receives a conſiderable Inforce-ment from the *Furca*, and near *Urfelen*, another from a mountainous Lake in *Oberalp*. Near *Flüelen*, not far from *Uri*, it enters the *IV. Waldſtetten Sea*, *Lacus quatuor Civitatum Sylveſtrium*, but reſumes it's Courſe and Name at *Lucern*, and at laſt falls into the *Aar* below *Windiſh*, *Vindoniſſa*.

The *Aar*, *Arola*, *Arula*, ariſes upon the high Mountain *Grimsſula*, in the upper *Valleſia*. About three Hours below that, it falls into the Lake of *Brientz*, and out of that, not far from the Monastery *Interlachen*, into the Lake of *Thun*, which it leaves near the Town of *Thun*, and thence running by *Bern*, *Solothurn*, and ſo down, falls at laſt, after many Windings and Turnings into the *Rhine* near *Coblentz*, *Confluentia*, probably ſo called from the uniting of theſe two conſiderable Rivers.



The Ascent of the Mountains of *Switzerland* being so very sudden and quick, that as I have shewn, the Elevation of the Mountains in the Canton of *Glarus* above the Horizon of *Zurich*, though not quite three Days distant, is more than three Times as great, as the Elevation of *Zurich* itself above the Level of the Ocean, of which it is upwards of 375 *English* Miles distant in a streight Line; and so in Proportion of others; and the Rivers, which arise in these Mountains, rushing down, in Consequence of so quick a Descent, with great Force and Impetuosity, it was to be feared, they would often overflow their Banks, and cause frequent Inundations in the flat Countries, (of which there are too many Instances in our own Valleys and Plains,) if this Force and Impetuosity was not in great Measure broke, and their Waters disposed to a more gentle Descent. And this is effectually done by those great Receptacles of Water, the Lakes, which are besides of infinite Use to the Inhabitants around them, supplying them with Plenty of Fish for their Sustenance, and enriching them by the Facility with which Commerce may be carried on over them. Thus the *Rhine* falls into the *Lacus Bodamicus*, *Boden-Sea*, the *Rhofne* into the *Lacus Lemannus*, or *Lake of Geneva*, the *Muesa* and *Thesin* into the *Lake of Locarno*, the *Reüs* into the *Lake of Lucern*, the *Adda* and *Maira* into the *Lake of Como*, the *Lint*, or *Limat*, into the *Lake of Zurich*, the *Aar*, into the Lakes of *Brientz* and *Thun*. And it seems, that the more considerable the Rivers are, and the more impetuous their Course, so much the greater must the Receptacles be, wherein they are to lose their Force and Rapidity. The *Lake of Geneva*, and the *Boden-Sea*, the two largest in *Switzerland*, evidently evince what I here assert, and the others above-named gradually decrease in Largeness, in proportion as the Rivers, which fall into them, are less and less rapid.

*An Account  
of the Nature  
and Virtues of  
the Holt-Wa-  
ters, by the  
Rev. Mr J.  
Lewis, Vicar  
of the Place.  
No. 408.  
pag. 43.*

VIII. Experience has proved them of admirable Efficacy in Scorbatic and Scrophulous Cases: wherein they have done such Wonders, that a short Account which was published of their Cures in that Kind, above five Years ago, was looked upon by some, rather as a romantic Tale, than a true Narrative of real Facts.

They are of an attenuating, astringent, and drying Nature: And by these Qualities, I imagine, they perform their Cures. The first is the known Property of all Water, to dilute the Blood, and thin the Juices, and thereby to fit them to pass the fine Strainers, and be carried out of the Body by their proper Drains. In the Second consists the great Excellence of *Holt-Water*, which, by it's notable Astringency, braces the Solids, stimulates the Fibres, and quickens their contractile Power, and thereby enables them to shake off, protrude and squeeze out such Feculencies, as may adhere to, clog and stuff them up. And this Quality, it is probable, they derive from the Allom and Iron that are supposed to impregnate them. The Ingredients, which give them their drying, absorbing and healing Quality,



Quality, are the Sulphur and Ochre; by which they imbibe the peccant Humours, and sheath the sharp Salts, that lance and tear the finer Glands, and cause Blotches, and Ulcerations. As they attenuate and astringe, they are a noble Diuretic, removing Obstructions from the Kidnies, and causing the Renal Glands to make their due Secretions, and at the same Time dissolving the grosser Salts, and fitting them to be carried off through the Urinary Passages.

These Waters have been found of excellent Avail in many other Illnesses, besides the Scurvy and Evil.

IX. The following Conjectures upon the Subject of intermitting and reciprocating Springs, were suggested to me by the Phænomena of a particular Fountain, seen by my self this last Winter. I am sensible that my Observations made on it are very imperfect, in Comparison of what the *Society* may expect, and I my self hope hereafter to give them: And as the Conjectures were framed chiefly for my own use, against another Opportunity of observing this Fountain more carefully; so they are now communicated only for the use of others, who may perchance find such an Opportunity before me. These Observations will however discover something of the Nature of this Spring not yet imparted to the *Society*, nor taken notice of by the Naturalists, so far as I know, in any other Spring whatsoever. But since they are few, and imperfect, I shall be more particular in my Relation of them, that no greater Stress may be laid on them than they deserve.

*Conjectures upon the Nature of Intermitting and Reciprocating Springs. By Mr Joseph Atwell, F.R.S. No. 424. pag. 301.*

The Spring is situated at one End of the Town of *Brixam* near *Torbay* in *Devonshire*, and is known by the Name of *Laywell*. It is a long Mile distant from the Sea, upon the North and North-East Side of a Ridge of Hills lying between it and the Sea, and making a Turn or Angle near this Spring. It is situated in the Side of those Hills, near the Bottom, and seems to have it's Course from the South-West towards the North-East. There is a constantly running Stream which discharges itself near one Corner into a Bason about eight Foot in Length, and four Foot and a half in Breadth; the Outlet of which is at the farthest End from the Entrance of the Stream, about three Foot wide, and of a sufficient Height. This I mention, that a better Judgment may be made of the perpendicular Rise of the Water in the Bason, at the time of the Flux or Increase of the Stream. Upon the outside of the Bason are three other Springs, which always run, but with Streams subject to a like regular Increase and Decrease with the former. They seem indeed only Branches of the former, or rather Channels discharging some Parts of the constantly running Water, which could not empty itself all into the Bason; and therefore when by means of the Season, or Weather, Springs are large and high, upon the Flux or Increase of this Fountain several other little Springs are said to break forth, both in the Bottom of the Bason,



and without it, which disappear again upon the Ebb or Decrease of the Fountain. All the constantly running Streams put together, at the time that I saw them, were, I believe, more than sufficient to drive an Over-shut Mill; and the Stream running into the Basin, might be about one half of the whole.

I had made a Journey purposely to see it, in Company with a Friend. When we came to the Fountain, we were informed by a Man, working just by the Basin, that the Spring had flowed and ebbed about twenty times that Morning; but had ceased doing so, about half an Hour before we came. I observed the Stream running into the Basin, for more than an Hour by my Watch, without perceiving the least Variation in it, or the least Alteration in the Height of the Surface of the Water in the Basin; which we could observe with great Nicety, by means of a broad Stone laid in a shelving Position in the Water. Thus disappointed, we were obliged to go and take some little Refreshment at our Inn; after which we intended to come back and spend the rest of our Time by the Fountain, before we returned Home. They told us in the Town, that many had been disappointed in this manner; and the common People superstitiously imputed it to I know not what Influence which the Presence of some People had over the Fountain; for which reason they advised, that in case it did not flow and ebb when we were both present, one of us should absent himself, to try whether it would do so in the Presence of the other.

Upon our Return to it, the Man, who was still at work, told us, that it began to flow and ebb about half an Hour after we went away, and had done so ten or twelve times. In less than a Minute, we saw the Stream coming into the Basin, and likewise the others on the outside of the Basin, begin to encrease and to flow with great Violence; upon which the Surface of the Water in the Basin rose an Inch and a quarter perpendicularly, in near the Space of two Minutes: Immediately after which, the Stream began to abate again to it's ordinary Course; and in near two Minutes time the Surface was sunk down to it's usual Height, where it remained near two Minutes more. Then it began to flow again as before; and in the Space of twenty-six Minutes flowed and ebbed five times: So that an Increase, Decrease, and Pause, taken together, were made in about five Minutes, or a little more.

I could observe by the Mark upon the Stones, that the Surface of the Water in the Basin had risen before we came at least three Quarters of an Inch perpendicularly higher than when we saw it; and I thought that I could perceive some very little Abatement each Turn, both in the Height, and in the Time of the rising of the Surface, and consequently in the Time of it's sinking; but the Time of the Pause, or standing of the Surface at it's usual Height, or equable running of the Stream, was lengthened; yet so, as to leave  
some



some Abatement in the time of the rising, sinking, and pause taken together. This is all which my short Time would allow me to observe; many more things should have been taken notice of, as will appear from the Hypothesis proposed to explain these Phænomena.

But before I enter upon explaining that Hypothesis, I must remark what Difference or Agreement is to be found between this Account of the Fountain, and another published in the *Philos. Trans.* Numb. 204. p. 909, 910, in two Letters from Dr *Oliver* to *Walter Moyle*, Esq; The Doctor places it a Mile and half from *Brixam*: I suppose he means *Brixam-Quay*, which is more than a Mile off from the Town. He gives the Dimensions of the Bason a little different from mine, making the Surface of it thirty Foot square, whereas I make it thirty-six Foot. He says, that it ebbs and flows very often every Hour; which is certainly false, as appears both by common Report, and by my own Observation. When it once begins indeed to flow and ebb, it continues to do so several times in an Hour; but then there is after this again a certain Space of Time, perhaps two Hours or more, when it runs with an equable Stream, without any the least Variation: And this is a particular Circumstance not observed in any Spring whatsoever that I have heard of. When the Doctor first saw it, *viz.* in *July* 1693, he says that he judged the Flux and Reflux, as he calls them, to be performed in about two Minutes: If he means two Minutes each, it agrees very well with my own Observations; but as he had neither Glass nor Minute-Watch with him, this Observation cannot be depended on. When he saw it again, *viz.* in *August* the same Year, he judged it to flow slower than before; which he explains by saying, that though it performed it's Flux and Reflux in little more than a Minute (which by the way is quicker than before) yet it would stand at the Low-Water Mark two or three Minutes; which I suppose he calls flowing slower than before, because the Space of Time between the End of the Ebb and the Beginning of the succeeding Flux was longer. I had never read this Account 'till lately; long since my own Observations were made; but, if we suppose the Doctor to have made his Observations somewhat nearer the Time when the Fountain was to cease ebbing and flowing, than I made mine, our Observations will perhaps exactly agree: The Time of the Flux and Reflux being shorter, the Time of the Pause longer, but the whole Time of the Flux, Reflux, and Pause taken together, being shorter by his Account than by my own. He says, that he found it by his Watch to flow and ebb sixteen Times in an Hour: I do not suppose that he made a whole Hour's Observations, which must have shewn him a Difference in the Times of the Reciprocations that he did not perceive; but having observed, that one Reciprocation, or a Flux, Reflux, and Pause, took up about the Space of four Minutes, he from thence computed,



## Of Intermitting and Reciprocating Springs.

as I imagine, that there would be sixteen in an Hour, presuming that there was no Alteration in the Times. In this sense I would understand him, when he adds, that he was informed it sometimes flowed twenty Times in an Hour. For, according to his Observation, it flowed at the rate of sixteen Times in an Hour, according to my own Observations, at the rate of twelve Times in an Hour; perhaps before my Observations at a less Rate, and after his at a greater: So that in the whole Hour, according to the several Rates taken together, it may flow and ebb about nine or ten Times, according to another Account which I have received; but of this I can assert nothing certain, or upon my own Observations. The Doctor adds, that when the Water in the Bason began to rise, he observed a Bubbling in the Bottom of the Bason, which ceased when the Water began to sink. This I did not see, because the Springs were small and low, by means of a dry Season; but it was confirmed to me by the Report of Eye-witnesses, as is before observed.

Having thus compared the two Accounts given of this Fountain, I come now to my Hypothesis, for explaining the Phænomena observed by me; and I imagine them to be occasioned by two Streams or Springs, one of which passing through two Caverns or natural Reservoirs with Syphons, meets with the other Stream in a third Reservoir without a Syphon; where being joined, they come out of the Earth together. This complicated Piece of Machinery will be best understood by beginning with an Explanation of the more simple Parts first; in doing of which, we shall have an Opportunity of considering some other Sorts of Fountains, which have already been observed, or may hereafter be found to be in Nature.

The *Petitio Principii*, or Supposition of Reservoirs and Syphons in the Bowels of the Earth, has been made by others: *Père Regnault*, in his *Phil. Conversations*, Vol. 2. Conv. 6. p. 125, &c. *Eng. Edit.* has mentioned it in general, and *Dr Desaguliers*, in *Phil. Transf.* Numb. 384, has attempted to apply it to two Cases in particular; as *Dechaies*, Tract. xvii. *de Fontibus Naturalibus*, &c. Prop. xv. had done in two other Cases before him. Nor is it unnatural or hard to be granted. Whosoever has seen the *Peak of Derbyshire*, the Hilly Parts of *Wales*, or other Countries, must be satisfied that they abound with Caverns of many sorts. Some of them are dry, others serve only for Passages, or Channels to Streams, which run through them; and a third Sort collect and hold Water, 'till they are full. They must likewise have observed, that there are sometimes narrow Passages running between the Rocks which compose the Sides, and going from one Cavern to another. Such a Passage, of whatsoever Shape or Dimensions, how crooked and winding soever in it's Course, if it be but tight, and runs from the lower Part of the Cavern first upwards to a less Height than of the Cavern, and then downwards below the Mouth of the said Passage, will be a natural Syphon.

A natural



A natural Reservoir then, A B C D, with such a natural Syphon, M N P may be supposed. Let a Stream, which I shall call the Feeding-Stream, enter it, near the Top at O. The said Cavern must contain all the Water which comes in at O, 'till it is filled to the Top of the Syphon at N. Then the Syphon beginning to play, and being supposed always to discharge more Water than comes in by the Feeding-Stream at O, will empty the Cavern, 'till the Water is sunk in it below the Mouth of the Syphon at M, when it must stop, 'till the Cavern is filled, and the Syphon runs again as before. If the Water discharged by such a Syphon, M P be brought out of the Earth by a Channel P Q, the Water will flow out of the Earth, and stop alternately, making an intermittent Fountain at Q.

By this plain and easy Contrivance, several of the flowing and ebbing Springs observed by the Naturalists, may probably be explained; and even a much greater Variety of them than is hitherto known. For if the Feeding-Stream at O should arise only from the Rains in Winter, or from the melting of the Snow in Summer, the intermittent Fountain would become a temporary Spring, as Dr Plot calls such Springs which are confined to a Season. Or if the Feeding-Stream at O should be constant, but yet liable with other Springs to an Encrease and Decrease arising from the Seasons, Weather, or other Causes, the Construction of the Syphon would make a great Alteration. For when the Syphon is so made that it's Discharge (which is continually decreasing, as the Surface of the Water subsides in the Cavern) shall at any Time be equal to the Feeding-Stream entering at O, in such a Case, the Syphon must continually run, and yet not empty the Cavern, 'till the Feeding-Stream at O is sufficiently diminished. But, when the Diameter of the Syphon at N, according to the Height of the Cavern, is so great, and the Feeding-Stream at O so small, that the Syphon can carry off (in the Manner of a Waste-Pipe) all the Water which comes in, and yet not run with a full Stream; the Syphon must then continue to run without emptying the Cavern, 'till the Feeding-Stream at O is sufficiently enlarged. So that by these different Constructions of the Syphon, there may be some Fountains which shall flow constantly in the Winter, or a wet Season, and intermit in the Summer, or a dry Season; and on the contrary, others which shall flow continually in the Summer, or a dry Season, and intermit in the Winter, or a wet Season. There is a third Variety, which may arise from the Make of the Syphon, and will occasion such Irregularities as admit of no certain Explanation. This happens when the Discharge of the Syphon at the very last is just equal to the Feeding-Stream, and the Cavity of the Syphon at N is large; for in this Case, the Air-Bubbles, made by the Fall of the Feeding-Stream from O to the Bottom of the Cavern, will sometimes accidentally get into the Mouth of the Syphon at M, and lodging at N, will so choak it as to render it's running and stopping, as well as



the Quantity of its Discharge, entirely uncertain; so that these sort of Fountains will admit of no farther Consideration.

But before I leave the Consideration of Fountains explicable by one Reservoir and Syphon, it may not be amiss to observe, that those which intermit regularly will have their Flux always longer, and their Pause or Intermision shorter in Winter and in wet Weather, than in Summer or in a dry Season; which is a Consequence of this Hypothesis, by which it may be examined, whether it be applicable to any particular intermitting Fountain, or not.

Fig. 33.

If the single Reservoir and Syphon has another Out-let at R, situated between the Bottom CD of the Cavern, and the Top of the Syphon N, we shall have another kind of Fountains. For if the Feeding-Stream at O, is capable of being discharged by the Out-let at R, a Fountain derived from R will continually run, whilst the Feeding-Stream can be discharged that Way, and will encrease and decrease with any little Alteration happening to the Feeding-Stream at O, provided that the said Stream does not grow too large for the Out-let at R. But in that Case the Cavern must be filled up to N, and the Syphon may begin to play; which, together with the Out-let at R, may discharge so much as to make the Surface of the Water in the Cavern sink below R, and consequently the Fountain proceeding from R must stop. If the Discharge of the Syphon is so great as to empty the Cavern, then the Fountain derived from R will, after some time, begin to run again, and encrease 'till the Water rises in the Cavern to N; after which it will decrease, and at length stop. But if the Discharge of the Syphon only keeps the Surface of the Water below R, without emptying the Cavern, then the Fountain derived from R shall be dried up, so long as the Stream at O continues encreased; and shall run again when the said Feeding-Stream is lessened. Thus we may have a Spring which shall run all Summer, and be dry all Winter: Such a Spring will encrease just before it begins to fail, *i. e.* whilst the Water in the Cavern is rising to N, will be dried up sooner in a wet Summer, and break out later in a wet Winter, contrary to the Nature of other Springs. Which Particulars are worthy of Observation in such sort of Springs (of which it is said we have some in *England*) and will serve to discover, whether they are occasioned by this kind of Machinery, or not.

Fig. 34.

If the Syphon MNP, of the Reservoir ABCD, having no Out-let at R, should discharge itself into a second Reservoir EFGH of a smaller Capacity, but furnished with a Syphon STV, which discharges the Water more plentifully than it comes in; a Fountain derived from this second Syphon STV would flow and intermit, whilst the first Syphon MNP continued running; *i. e.* 'till the great Reservoir ABCD should be emptied. After which it would entirely stop, 'till the said Reservoir ABCD was filled again by the Feeding-



Feeding-Stream at O, and then it would flow and intermit as before.

Such a Sort of compound Fountain would be liable to all the Variations of the former Fountains derived from a single Reservoir, if we take the Fits of flowing and intermitting of this for the Flux of the Former, and the long Stop in this, whilst the great Reservoir is filling, for the Pause or Intermission of the former. Besides which, we must remark, that as the Flux in the former Fountains may be changed, and be made longer or shorter; so in this the Number of Intermissions during one Fit of flowing and intermitting may not always be the same, because of the different Capacities of the two Reservoirs, and a Difference or Change occasioned in the Feeding-Stream at O. For if, whilst the great Reservoir A B C D is emptying, the little Reservoir E F G H should empty itself nine times, for Instance, and be half full again, the Fountain derived from it's Syphon S T V must have nine Intermissions in one Fit, and ten in another, alternately, whilst the Feeding-Stream at O remains the same. But the Feeding-Stream at O being lessened or enlarged, without making the Syphon M N P run continually, the Number of Intermissions in each Fit will be diminished or augmented accordingly. But 'tis peculiar to this last Sort of Fountains, that in each Fit of flowing and intermitting the first Flux will be larger and longer than the second, and the second than the third; but the first Intermission will be shorter than the second, and the second than the third: because the Syphon M N P running faster at first than at last, the Reservoir E F G H must be a shorter Time in being filled, and a longer Time in being emptied the first Time than the second; the second than the third, and so on. As to the whole Time of the first Flux and Intermission, in Comparison of the whole Time of the second Flux and Intermission, it is a Particular, requiring so many Things to be taken into Consideration for determining it in each Case, that I shall wave it here, and content myself with shewing that it may be longer, by an Experiment that will presently be made. Another Variety in this Sort of Fountains might be made by a second Feeding-Stream Z, coming into the second Reservoir E F G H; but the bare mentioning of that will at present be sufficient.

If in the Contrivance of a single Reservoir and Syphon, the Stream derived from the Syphon should fall into another Reservoir I K K L, *Fig. 35* having no Syphon, but only a common Out-let X, and should in this Reservoir meet and join with another Stream constantly running, a Fountain derived from the said Out-let X would be a Reciprocating Spring; by which Name I call those Springs which flow constantly, but with a Stream subject to encrease and decrease, to distinguish them from Intermittent-Springs, which flow and stop alternately. And if the Out let X be too small to carry off all the Water brought into the Reservoir I K K L, by the Syphon, over and above what is brought in by the constantly running Stream W; then the Surface

of



## Of Intermittent and Reciprocating Springs.

of the Water in the said Reservoir I K K L must continually rise, 'till the Velocity of the Stream going out at X, is sufficiently encreased to carry off the Water coming in : Upon which, the Discharge of the Syphon being continually lessened, the said Surface will again subside, and the Velocity of the Stream at X will diminish ; so that both the Encrease and Decrease in this Reciprocating Fountain will be gradual. Besides, if the Reservoir I K K L, or the Channel derived from it, should have any Leaks, Crevices, or other Out-lets, the Water will issue through them upon the Rising of the Surface in the said Reservoir, and occasion Springs, which will cease again when the Surface subsides.

Fig. 36.

Let us now suppose such a Reservoir I K K L, with a constantly running Stream W, and an Out-let X, to receive the Water of a Syphon S T V, coming through two Reservoirs A B C D and E F G H, as before described. A Fountain derived from X in this Case, would be an intermitting Reciprocating Spring, whose Stream would reciprocate, but whose Reciprocations would sometimes stop, and have Fits of Intermission.

Such, in all probability, is the Fountain called *Laywell*, before described, whose Phænomena gave occasion to these Thoughts, and seem capable of being accounted for by such a Contrivance. And for the better Discovery of the Nature of this Fountain, whether it is owing to such a Piece of Natural Machinery, or otherwise, it would be proper to observe the length of Time of each Increase, Decrease, and Pause in every Reciprocation, together with the Number of Reciprocations in every Reciprocating-Fit, and likewise the length of the Intermissions of the said Fits. These Observations should be continued for some Time, both in a settled Season, when the Feeding-Stream at O cannot change, and in Variety of Seasons, when the said Stream may be altered.

Having now brought these Thoughts to the End proposed, viz. an Explanation of such a Fountain as *Laywell*, I shall carry them no farther ; but conclude, by presenting to the View, an artificial Fountain of this kind, which being very easily made, may be buried in the Bottom or Slope of a Terrass, where a constant Stream of Water can be brought, and will furnish us with a new sort of Water-Works in Gardens. The two Reservoirs A B C D, E F G H, with their Syphons M N P, S T V, and the third Reservoir I K K L, with it's Out-let X, are included in a Box Y Y Y Y. Into this Box at  $\lambda$  enters a Funnel  $\Gamma \lambda \Gamma$  divided within the Box into two Pipes, viz.  $\lambda O$ , which serves for a Feeding-Stream to the great Reservoir, and  $\lambda W$ , which serves for a constant Stream to the third Reservoir. A Stream of Water being let into the Funnel  $\Gamma \lambda \Gamma$ , will discharge itself like such an intermitting Reciprocating-Fountain at X, where there is a Basen Y Z Z Z without the Box to receive it ; with an Out-let  $\alpha$ , and a Diagonal Gage Z Y, to mark the Rise and Fall of the Water in the Basen.

Fig. 36.



# C H A P. III.

## M I N E R A L O G Y.

I. 1. **T**HE following Observations are the Particulars of what I observed during a Year's Stay in the Western Part of *Cornwall*, concerning *Mines*, &c.

*Some Observations towards composing a Natural History of Mines and Metals, by Dr Fr. Nicholls, No. 401. pag. 402.*

*Mines in general* are Veins or Cavities within the Earth, whose Sides receding from, or approaching nearer to, each other, make them of unequal Breadths in different Places; sometimes forming large Spaces, which are called *Holes*. They are filled with Substances, which, whether metallic, or of any other Nature, are termed the *Loads*. When the Substances forming these Loads are reducible to Metal, the Loads are by the Miners said to be alive; otherwise they are termed dead Loads.

In *Cornwall* and *Devon* the Loads always hold their Course from Eastward to Westward; tho' in other Parts of *England* they frequently run from North to South. The Miners report, that the Sides of the Load never bear in a Perpendicular, but constantly underlay either to the North or South.

The Mines seem to be, or to have been, the Channels thro' which the Waters pass within the Earth; and, like Rivers, have their small Branches opening into them in all Directions; which are by the Miners termed, the Feeders of the Load.

Most Mines have Streams of Water running thro' them, and when they are found dry, it seems to be owing to the Waters having changed their Course, as compelled to it, either because the Load had stopped up the ancient Passages, or that some new and more easy ones are made.

The Load is frequently intercepted by the crossing of a Vein of Earth, or Stone, or some different metallick Substance. In which Case it generally happens, that one Part of the Load is moved a considerable Distance to one Side. This transient Load is by the Miners termed a Flooding; and the Part of the Load which is moved, is, in their Terms, said to be heaved. This heaving the Load would be an inexpressible Loss to the Miner, did not Experience teach him, that, as the Loads always run on the Sides of the Hills, so the Part heaved is always moved towards the Descent of the Hill. So that the Miner working towards the Ascent of the Hill, and meeting a Flooding, considers himself as working in the Part heaved; wherefore cutting thro' the Flooding, he works upon



it's Back towards the Ascent of the Hill, till he recovers the Load, and *vice versâ*.

Fig. 37.

A D shews a Load running in the Side of a Hill, B the Feeders, C the Flooding, D is the Part heaved.

Fig. 38.

Fig. 39.

Sometimes, tho' not constantly, the Mine is lined with an intermediate Substance between the Load and itself. This is (properly speaking) the Wall of the Load: Though, in the common Acceptation of that Term, it signifies either such intermediate Substance, or the Side of the Mine, where the Load immediately unites itself to it. A is the Side of the Mine, B the intermediate Wall of white Mordic, C the Load of Copper. D E two Walls of Spar-Stone, F a small Vein of Tin Ore.

The Springs in these Parts are always hard, as abounding very much, either in stony, or sulphureo-saline Particles.

From this Water thus saturated with stony Particles, we frequently find the Passages of the Water under Ground, either partly, or totally stopped up; the stony Matter gradually concreting round the Sides of the Mine, and forming thereby a confused Load of Spar-Stone.

At other Times this stony Matter concretes more distinctly: In which Case the stony Matter seems to be governed in it's Concretion by a Plastic Power.

N. B. When I speak of a plastic Power, I would be understood as meaning only a Modus of Attraction, by which the attracted Particles are ranged in this or that determined Form. This Power then so exerts it's Action, as to range the concreting Matter into the Form of a hexagonal Prism, whose Head goes off in a hexagonal Pyramid. Where this plastic Power happens to be single and uncontrouled, it preserves the Form of the Crystal to very considerable Magnitudes.

Fig. 40.

In these single Crystals we may observe, that they are of different Transparencies and Colours, as the stony Matter is more or less disengaged from other Substances, or as those other Substances are capable of imparting different Tinctures to them. And that they seem formed *laminatim*; tho' the *Laminæ* are only distinguishable, when the Matters from whence the Crystal is successively formed, happen to differ in Purity. The Crystal A was at first formed from Matter intangled with a foul yellow Substance; after which, a pure Matter advening, the Crystal was in it's future Lamination formed more pure and transparent.

But where the plastic Particles are more numerous, there seems Reason to believe, that these very plastic Particles, before they are fixed, are subject to the Controul and Direction of any fixed plastic Particle, within the Verge of whose Activity they happen to move: notwithstanding which, after they are once fixed, they exert their own plastic Powers, and, in Conjunction with the first plastic Particle, govern the future Concretion, in such Manner as to form a

seemingly



Fig. 31.

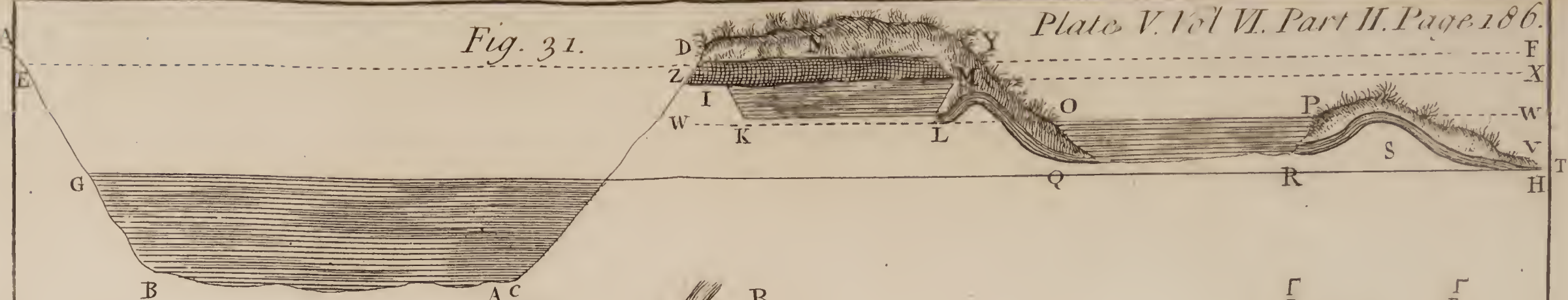


Fig. 32.

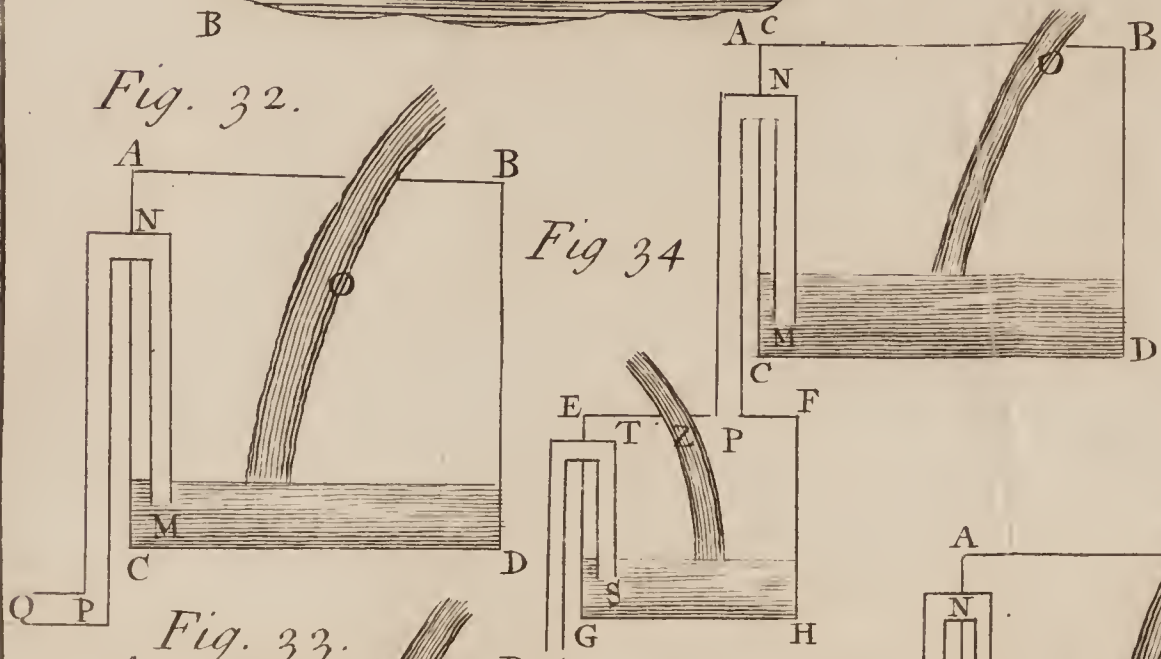


Fig. 34.

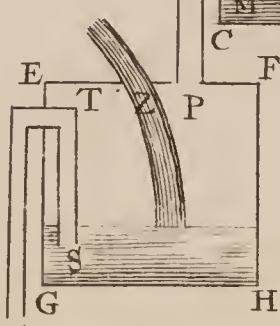


Fig. 33.

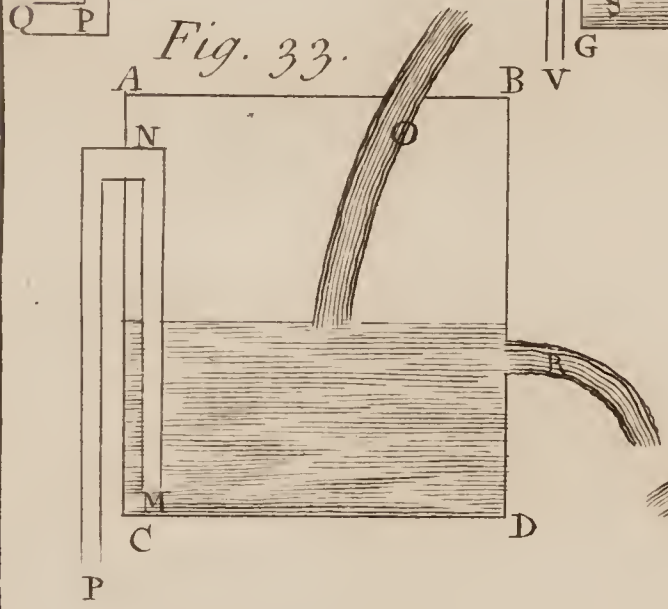


Fig. 35.

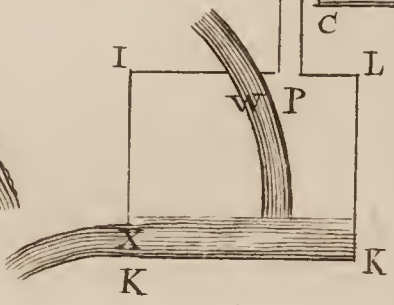


Fig. 36.

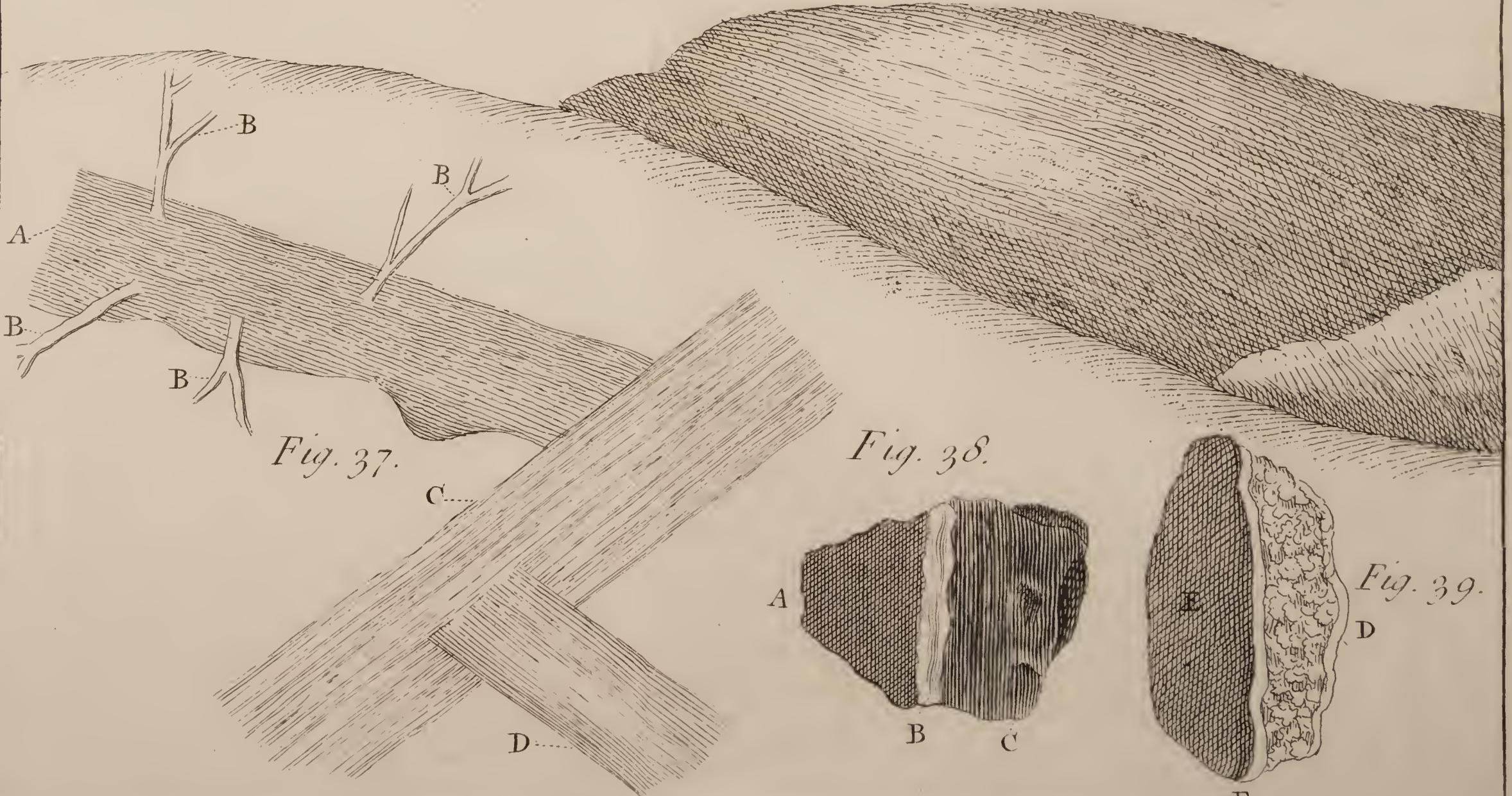
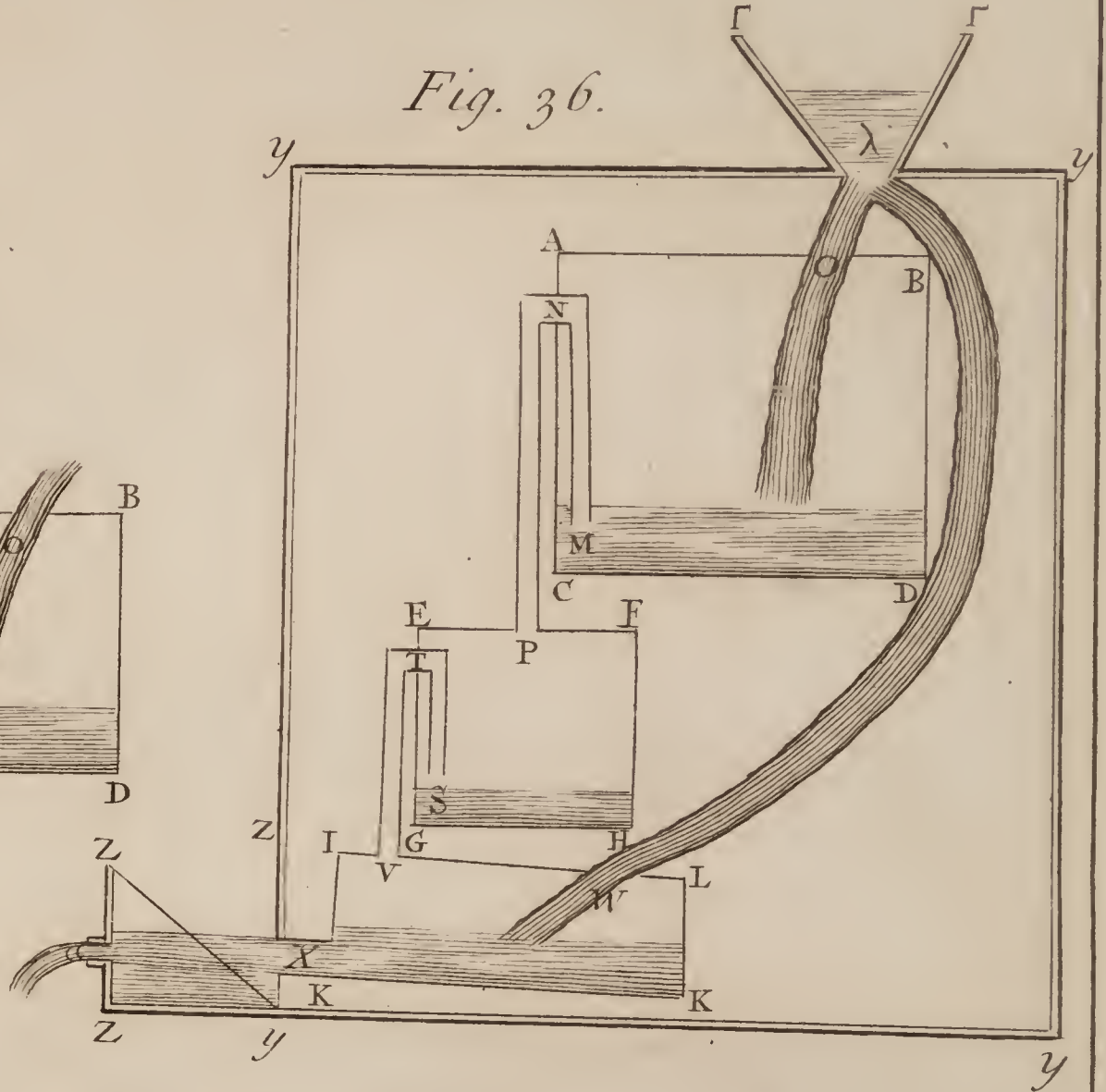


Fig. 37.

Fig. 38.

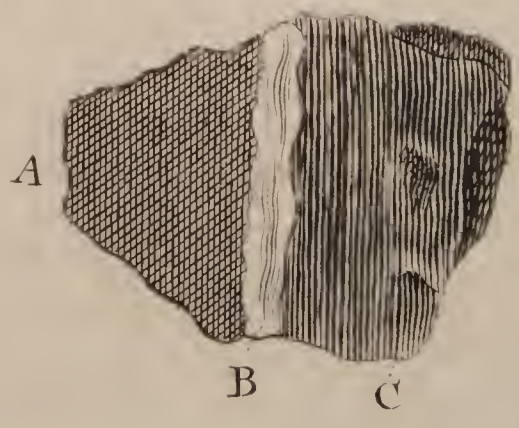
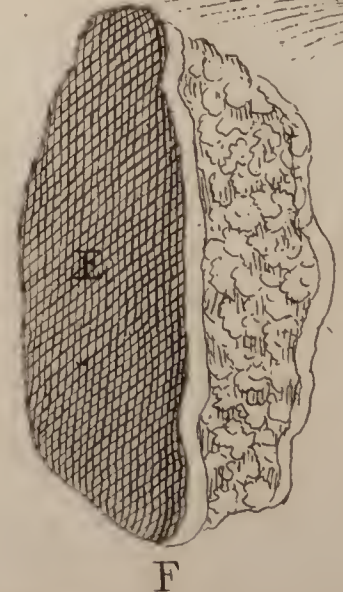


Fig. 39.









seemingly irregular Crystal, tho' composed of two or more regular Crystals. Thus A and C seem to have attracted amongst the stony *Fig. 41,* and Particles, two plastic Particles, which afterwards exerting their own *42.* Powers, form the additional Crystals B and D.

There are many Phænomena observable in these Crystals, which, at present, I may pass over, as less relating to the Affair of Metals; wherefore I shall only add, that these crystalline Concretions exert a strong Attraction on many metallic Substances. As the Spar A has *Fig. 43.* attracted the three Portions of Lead B. and the Crystals C have attracted the Copper D, and are attracted by the Lead E. *Fig. 44.*

The sulphureo-saline Particles, with which, as I observed, the Waters are frequently saturated, are found to be either of a vitriolic or an arsenical Nature: The first constantly, if pure, concreting into white Cubes resembling Grains of Silver, while the arsenical Sulphur concretes into yellow Cubes like Grains of pure Gold. Both these are by the Miners termed Mundic.

These sulphureo-saline Substances seem directed in their Concretions by a plastic Particle, in the same Manner as the Crystals above-mentioned; and, like them, upon the same Principles, are found simple or compound. In their Sides you may observe the Concretion forms itself like Threads, which in three Sides run in different Directions, but are always similar in the opposite Sides.

*Fig. 45.* shews one of these Cubes, A the parallel Threads. *Fig. 45.*

*Fig. 46.* shews another of these Cubes, from whose Sides arise *Fig. 46.* small Segments of Cubes C.

But this plastic Power seems to be weakened or destroyed, in Proportion, as this sulphureous Matter is more or less intangled with metallic Substances.

Thus in *Fig. 47.* the plastic Particle seems for a while to have exerted it's Power in the usual Manner, till the advening Matter grew intangled with a small Quantity of Copper, after which it seems only to have exerted it's attractive but not it's plastic Power. *Fig. 47.*

And in *Fig. 48.* the white Mundic being infected with Iron, seems *Fig. 48.* so far from being affected by a plastic Power, that it concreted in the Form of Icicles from the Fluid which transfused thro' the Top of the Mine.

*Fig. 49.* represents some small Cubes of white or vitriolic Mundic. *Fig. 49.*

But to return to the Mines: They are found to contain Iron, Tin, Lead, Copper, and a pseudometallic Substance, by the Miners termed Glift.

2. Of all the Substances concurring to form the terrestrial Globe, *Some farther* Iron probably bears the greatest Share; as it not only abounds in most *Observations* Kinds of Stone, shewing it self in Varieties of Crocus, all which gain *towards com-* a more intense Colour by Fire; but enters likewise greatly into the *passing a Nat.* Composition of common Clay; as may be judged from the Similitude *Hist. of Mines* and Metals, *and Metals,*



by the same  
No. 403.  
pag. 480.

Of IRON.

of Colour between Clay and dry Iron Ore; from the easy Vitrification of Clay; from the Resemblance between Clay so vitrified and the Clinkers of Iron; from it's deep red Colour after Calcination; and lastly, from it's yielding pure Iron, by being burned with Oil.

But while Iron is thus entangled with other Bodies, it rarely employs the Care of the Miner; who finds the Expence of reducing it to Metal too seldom ballanced by the Price it yields: For which Reason though we frequently meet with large and rich Loads of Iron, yet (the Woods having been applied to more advantageous Uses) they are there entirely neglected.

When it is most pure, I find the Ore under three different Appearances.

Paper the first contains a Piece of rich dry Iron Ore, whose Scrapings exactly resemble an *Alkohol Martis*: This Kind of Iron Ore has very nearly the Colour of common Clay.

Paper the second contains a Piece of rich Iron Ore, with Part of the Wall of the Load formed by a Concretion of yellow Crystals. In this Stone the Iron radiates from Points forming Segments of Spheres, and where these Spheres leave any Interstices, you will find a Crocus, or Oker.

Paper the third contains a Stone of Iron of the Kind used for burnishing Plate; it is of the Species of the *Hæmatites*.

Both these last Stones scrape into a deep Crocus.

From the second Instance we may conjecture, that the yellow Colour in Crystals arises from a Crocus entangled with the stony Salts.

Though the Want of Wood in *Cornwall* deprives it of the Advantages it might otherways reap from Iron as a Metal, we shall nevertheless find it far from being an useless Ore, when we consider it as sometimes impregnating the Waters with vitriolic Salts, thereby making them a proper Menstruum for dissolving the disseminated Particles of Metals; sometimes destroying the sulphureous Menstrua, which (though they dissolve the disseminated Metals) do nevertheless obstruct their new Concretions; and sometimes as being itself the Magnet by which the metallic Particles are attracted into new Concretions.

Of TIN.

The next metallick Substance found in *Cornwal*, and from which these Islands are supposed to take their Name, is *Tin*. It is never found but as an Ore; whereas Gold is never found but as a Metal, at least it's Ore is unknown, and all other Metals are found sometimes as a Metal, and sometimes as an Ore.

Tin always shoots into Crystals which are of different Magnitudes from two Ounces in a single Crystal to such as escape our Sight. These Crystals are for the most Part interspersed in Loads of other Substances



Paper the fourth contains Tin Crystals interspersed in a Load of a Kind of Clay, in which is observable a considerable Quantity of Red-oker.

Paper the fifth contains a Stone of hard Iron Stone, in which are exceeding small Crystals of Tin.

Paper the sixth contains somewhat larger Crystals, interspersed in a dry Red-oker.

Paper the seventh contains Tin Crystals, interspersed with Spar-stone and a Sort of Marl.

Paper the eighth contains larger Crystals, interspersed in a kind of Clay and Red-oker, as in Paper the fourth.

When a hundred Sacks of the Load (each containing more than a *Winchester* Bushel) yield one Gallon of clean Ore, the Load is esteemed very well worth working.

Sometimes these Crystals are so collected into one Mass, as to form Loads of pure Tin Ore, and so large as to yield to the Value of 100<sup>lb</sup>. every twenty-four Hours.

Paper the ninth contains two Stones of such pure Loads, in which observe the one is black, and the other nearly white.

These Crystals concrete sometimes into the Form of a Parallelopipedon, whose Summit is covered by a Pyramid; sometimes the Angles formed by the Sides of the Pyramid, and sometimes the Summit of the Pyramid are as it were plained away.

Paper the tenth contains several of these Crystals, of which Number the first contains a whole Crystal; which has none of it's Angles off. The second contains a Crystal which has only two of it's Angles plained away. The third contains a Crystal which has all it's Angles plained away. The fourth contains a Crystal which has all it's Angles and it's Summit plained away.

*Fig. 50.*

*Fig. 51.*

*Fig. 52.*

*Fig. 53.*

Sometimes the Crystals represent two equal pentelateral Pyramids joined at their Base.

As in Paper the eleventh, which contains two Clusters of Crystals, which considered separately are of that Form.

Under whatsoever Form these Crystals shoot, they always carry an exceeding fine Surface; which, when rubbed off, can be renewed by no Art. In Paper the fourth one Side of the Parallelopipedon is rubbed away to shew it's Appearance after losing it's natural Surface.

These Crystals are of different Colours from the White (like white Sugar candied) to the deep Black. Thus Paper the twelfth contains a group of small white Tin Crystals, which are very uncommon. These white Crystals seem to me to carry a finer Lustre than any other I ever saw, and are perfectly transparent; so that were they found of equal Size with the black Crystals, and of a white Water (which I imagine may be) their Hardness and Weight (in both which they exceed any other Fossil) would probably make them preferable



to the Diamond. However, as the deeper Colours of these Crystals seem to arise from a greater Proportion of Iron in their Composition, which they throw off in an Iron Slag upon Fusion, and which changes by proper Degrees of Heat into a Crocus, thereby changing the Colour of the Crystal to a brighter Red; so the white Tin Ore is certainly to be esteemed both richest and best, as most free from Iron.

Paper the thirteenth contains a Piece of the Load contained in Paper the seventh, in which the Crystals are of a brighter red, from it's being heated red-hot. (*These Specimens were all produced before the Society, and are since presented to Sir Hans Sloane, President.*)

These Crystals seem to be the heaviest Bodies the Earth produces, except Quicksilver and actual Metals. Their specific Gravity is to Water as  $90\frac{1}{2}$  to 10; to Rock Crystal in Water as  $90\frac{1}{2}$  to 26; to Diamond as  $90\frac{1}{2}$  to 34; and to pure malleable Tin, as found by repeated Trials, as  $90\frac{1}{2}$  to 78; from whence appears the Possibility of what some Miners affirm, viz. That a cubical Inch of some Tin Ores will yield more than a cubical Inch of Metal.

Having already taken Notice that the Crystals of Tin are sometimes so small as to escape the Eye, and so diffeminated in the Load as not to make above  $\frac{8}{1000}$ th, or  $\frac{10}{1000}$  Part of the Load, one would naturally imagine it an endless Labour to cleanse the Ore from such a vast Disproportion of Rubbish. But the great specific Gravity of these Crystals renders the cleaning it less troublesome, and less expensive, than in any other Ore whatever. It requires no more, than that the whole Stuff be stamped to a fine Powder, after which it is washed by a Water, whose Force is so moderated as to wash away only the lightest Parts. This Stamping and Washing is repeated till the Ore is left exceedingly clean, and yields in Metal from  $\frac{28}{100}$  to  $\frac{10}{100}$ , according as it is cleansed from the Load, and as it is in it's own Nature more or less free from Iron.

I Beg Leave to defer the Account of Lead and Copper.

*Some Observations on the Peak in Derbyshire, by John Martyn, F. R. S. No. 407. p. 22.*

*Mam-tor.*

II. The *Peak* is famous for seven Places, which have been dignified by our Ancestors, with the Name of Wonders: 1. *Chatsworth*, a magnificent Seat of his Grace the Duke of *Devonshire*; 2. *Mam-tor*; 3. *Elden-hole*; 4. *The ebbing and flowing Well*; 5. *Buxton-Well*; 6. *Peak's Hole*, and 7. *Pool's Hole*. The First being a Work, not of Nature, but Art, does not come within the Design of this Account. *Mam-tor* is a huge Precipice facing the East, or South-East; which is said to be perpetually shivering and throwing down great Stones on a smaller Mountain below it; and that nevertheless, neither the one increases, nor the other decreases in Bigness. This Mountain is composed chiefly of a Sort of Slate-Stone (called in that Country *Black Shale*) and great Stone. The Nature of the *Black Shale* is known to be, that notwithstanding it is very hard before it is exposed to the Air, yet it is afterwards very easily crumbled to Dust. Thus on



any Storm, or melting of Snow, this Shale is considerably wasted; and as the great Stones are gradually disengaged, they must necessarily fall down. That it is only at these Times that the Mountain wastes, is affirmed by the most intelligent of the neighbouring Inhabitants: And that this Decay is not perpetual, I can affirm myself; having not only taken a close Survey of it, but also climbed up the very Precipice, without seeing any other shivering in the Mountain, than what the treading of my own Feet in the loose crumbled Earth occasioned. That the Mountain does not decrease in the mean Time, is a Tale too frivolous to need any Consideration.

*Elden-hole*, is a huge perpendicular Chasm. The Depth of it is not known. Mr *Cotton* tells us, that he sounded 884 Yards, and yet the Plummet drew. But he might easily be deceived, unless his Plummet was of a very great Weight; for otherwise, I imagine the Weight of a Rope of that Length, would be so great as to make the Landing of the Plummet scarce perceivable. Be that as it will, the Depth of it is to be sure very considerable; and since have nowhere in *England* so good an Opportunity of searching the Bowels of the Earth to so great a Depth; I wonder no curious Person has ever had the Courage to venter down. It is said indeed, that a poor Fellow was hired to be let down with a Rope about his Middle, two hundred Yards; and that he was drawn up again, out of his Senses, and died a few Days after: And no Wonder, for the poor Wretch having nothing else to reflect on in that dismal Place, but the Danger he had put himself into for the Sake of a little Money, might probably be frightened out of his Senses. Or indeed the very Fatigue itself might put him into that Condition; as any one will easily imagine, who has been let down but a quarter of the Way, and drawn up again in that Manner. But I conceive, that if any intelligent and prudent Person was to be let down in a proper Machine; he would not be much in Danger, and his Fatigue would be very inconsiderable.

The *ebbing and flowing Well* is far from being regular, as some have pretended. It is very seldom seen by the Neighbours themselves; and, for my Part, I waited a good while at it to no Purpose.

*Buxton-Well* has been esteemed a Wonder on account of two Springs, one warm and the other cold, rising near each other. But the Wonder is now lost, both being blended together. The Spring which is now used for bathing, appears to be  $32\frac{1}{2}$  Degrees of one of Mr *Hawksbee's* Thermometers warmer than the common Spring-Water there \*.

*Peak's Hole* and *Pool's Hole* are two remarkable horizontal Openings under Mountains, the one near *Castleton*, the other just by *Buxton*. They seem to me to have owed their Original to the Springs which

\* The Spring Water kept the Spirit of Wine at 41, the Bath Water raised it to 82.



have their Current through them. It is easy to imagine that when the Water had forced it's Way through the horizontal Fissures of the *Strata*, and had carried the loose Earth away with it, the loose Stones must of Course fall down; and that where the *Strata* had few or no Fissures, they remained entire, and so formed those very irregular Arches which are so much wondered at in these Places. Whether this be the true Origin of these Caves or not, I submit to those who shall hereafter have the Curiosity to examine. It seems more probable to me, than what others have hitherto proposed. The three Rivers, as they are commonly called, in *Peak's Hole* are only some Parts of the Cave deeper than the rest, and receiving all their Water from the Spring which comes from the farther End of the Cave. The Water which passes through *Pool's-hole* is impregnated with Particles of Limestone, and so has incruited almost the whole Cave in such a Manner, that it appears like one solid Rock.

*Lead-mines.*

The *Lead-mines* in *Derbyshire* are very various with regard to their Courses. One into which I went down had two Branches; one running to the N. E. the other to the N. W. and as I was informed, one of the best they ever discovered ran due North. Their Breadth and Depth are full as irregular. The Bodies through which they dig to come at the Vein are generally *Limestone* and *Black Shale*. But it is uncertain which of the two is uppermost. Of two Mines into which I went down, in one they had digged first through 26 Yards of *Limestone*, then through one of *Black Shale*: In the other first through 42 Yards of *Shale*, and then through 28 of *Limestone*. The Substances which they find mixt with the *Ore*, are.

*Chert.*

1. *Chert*. This is a kind of *Flint*, which Dr. Woodward \* says is called so, when it is found in thin *Strata*. But in the *Peak* the *Strata* of *Chert* are often four Yards thick, or thicker. They are found in *Limestone*, and not always disposed in *Strata*. Those which I took notice of were generally either black, or of such a Colour as the inspissated Juice of the *Buckthorn* Berries, which the Painters call by the Name of *Sap-green*: Whence they are called *Green Cherts* and *Black Cherts*.

*Spar.*

2. *Spar*: This is composed of *Crystal* mixt with other Bodies. Those which they call *Sugar-Spars*, are those whose CrySTALLIZATIONS are very small, and so on crumbling to Pieces have the Appearance of powdered Sugar. I have two sorts of these; white and blue. *Dog-tooth Spar* is a white pointed Spar, in Form and Colour something resembling Teeth.

*Cauk.*

3. *Cauk*. This Dr. Woodward † says is a coarse talky Spar. But in that Substance which I met with in this Country under the name of *Cauk*; I could not discover any Flexibility or Elasticity, which that learned Writer has set down as Characteristicks of *Talk* and *Talky*

\* Method of Fossils, pag. 21.

† Ibid. pag. 18.



*Bodies.* \* It seems to me to be nothing but *Spar* incorporated with a coarse earthy Matter. When this *Cauk* is mixt with pellucid Crystalizations of *Spar*, it is called Bastard *Cauk*.

There are several other Bodies mixt in the Mines with *Lead-ore*: But as they did not occur in those Mines which I examined, I shall omit the Mention of them.

When the *Ore* is brought up from the Mine it is broken to Pieces that the *Spar*, *Cauk*, or other Bodies which adhered to it, may be the more easily separated. It is then thrown into a large Sieve and washed, and so farther purified from extraneous Bodies. After this, it is carried to the Furnace in order to be smelted. The Furnace, which I saw near *Worksworth*, was very rude and simple, consisting only of some large rough Stones, placed in such a Manner as to form a square Cavity, into which the Ore and Coals are thrown *stratum super stratum*; two great Bellows continually blowing the Fire, being moved alternately by Water. I saw no other Fuel used on this Occasion but dried Sticks, which they call white Coal. † Mr *Ray* informs us, that they use both white and black Coal or Charcoal in *Cardiganshire*. I suppose because that Ore is harder to flux; the Charcoal making a more vehement Fire. They generally throw in some *Spar* along with the Ore, which is thought by imbibing the Sulphur to make it flux more easily. They frequently throw in also some Cowke (or Cinders of Pit-coal) because they think it attracts the Dross, and so makes an easier Separation of it from the Lead. When the Ore is melted, it runs out at an Opening in the Bottom Part of the Front of the Furnace, through a small Channel made for that Purpose, into a cylindrical Vessel, out of which it is laded into the Mould. The Dross of the Ore on smelting is called *Slag*. This *Slag* is afterwards smelted again with Cowke only, and the Lead obtained from it is called *Slag-lead*. Their Way of making *Red-lead* is the same with || Mr *Ray*'s Account; only they use three Parts of Lead, and one of *Slag-lead*; and think that the *Red-lead* made thus is better than if made without *Slag-lead*.

III. The *Engine* consists of a Triple *Crank* working three *Pumps*, which both suck and force Air, by Means of three *Regulators*, and are alternately applied to drive Air into, or draw it from any Place assigned, thro' square wooden Trunks; which being made of slit Deal, and 10 Inches wide in the Inside, are easily portable, and joined to one another without any Trouble.

*Experim. I.]* I filled a tall cylindric Glass with the Steams of a burning Candle and burning Brimstone Matches, in such Manner that a lighted Candle would go out almost as soon as it was let down into that foul Air. Then fixing the Trunks (or square Pipes) to the

*Working of  
Lead Ore.*

*Red-Lead.*

*An Attempt  
made before  
the Royal So-  
ciety, to shew  
how Damps,  
or foul Air,  
may be drawn  
out of any  
Sort of Mines;*

*&c. by an  
Engine con-  
trived by the  
Rev. J. T.  
Desaguliers,  
LL.D. and  
F. R. S. No.  
400. pag.  
353.*

\* Catalogue of Fossils, Vol. i. part i. p. 57.  
Ed. 2. p. 174. || Ibid. p. 200.

† Collections of English Words,



forcing Hole of the Engine, I drove fresh Air into the Bottom of the above-mentioned Receiver; so that the foul Steam came out at the Top of the Receiver, which was open.

*Experim. II.* Having filled another Receiver (close at Top) with foul Steams, as before, I placed it in a Position almost horizontal, only with the close End something above the open End, that the foul Steam might not go out of itself, when specifically lighter than common Air. I fixed the Trunks to the Sucking-hole of the Engine; and by working the Engine, drew out the foul Steams from every Part of the Receiver, as the Trunks were applied to them successively.

*Experim. III.* Having filled with foul Steams, and set upright (as in the first Experiment) the cylindric open Receiver, I applied the Trunks to the sucking Part of the Engine, with their open End near the Bottom of the Receiver. Then, by pumping, the Steams were all drawn downwards, and so out at the Top of the Trunks at the Engine; whereas, in the first Experiment, they were driven out at the Top of the Receiver.

*Experim. IV.* Having set a Candle in the cylindric Receiver above-mentioned, without having filled it with Steams, and let down the Trunks into the Receiver, below the Flame of the Candle, I laid the wet Leather over the Mouth of the Receiver, leaving about Half an Inch open, for the Air to come in, notwithstanding which the Candle began to dwindle, and be ready to go out; but working the Engine with the Trunks joined to the forcing Part, the Candle revived, and burned, at last, as well as in the open Air. When I had left off Pumping, the Flame of the Candle diminished again; but when it was ready to go out, it revived again, upon forcing in more Air with the Engine.

*Remarks upon  
the Experi-  
ments.*

When Damps in Mines are specifically lighter than common Air, they will be driven out of the Mine by the first Experiment.

When Damps are specifically heavier than common Air, they may be sucked out by the Second or Third Experiment.

When a *Sough*, or *Adit*, is carried from a Mine to any distant Valley, to discharge the Water, or save the Trouble of raising it quite to the Top of the Pit, *Shafts*, or perpendicular Pits are generally sunk from the Surface of the Earth to the said Sough, to prevent the Workmen from being suffocated as they dig the Sough, and that at a great Expence; but, by the fourth Experiment, fresh Air may be driven down to the Workmen, to continue their breathing free and safe, and to keep in their Candles; by which Means the Expence of perpendicular Shafts will be saved.

It has been found by several Experiments, that a Man may breath a Gallon of Air in One Minute, and a Candle of Six in the Pound will burn nearly as long in the same Quantity of Air; therefore the Model only is capable of supplying fresh Air to One Man; and consequently,



frequently, a large Engine will abundantly supply Air for the burning of Candles, and the Working of a great Number of Men in a Mine.

One Man may work an Engine like the Model, and bigger every way in the Proportion of a Foot to an Inch.

As at every Stroke, 14 *cylindric* (or 11 *cubic*) Feet of Air are driven in, or as many cubic Feet of Damp sucked out, if the Axis of the Cranks be turned round 60 Times in a Minute, one Man, in that Time, may change the whole Air in a cubic Space, whose Side is 8 Feet; and one Horse, by working 24 Pumps with Half the Velocity, will easily do four Times the Work of one Man.

The Engines work with a great deal of Ease, because no Pressure of Atmosphere is to be removed; only a Velocity to be given to one Sort of Air, to change it for another.

Fire will not do in all Cases, though in some, it will draw foul Air out of Mines with success; because several Sorts of Damps extinguish Fire, and some fulminate, and are dangerous, when Fire comes near them; and even in common stagnant Air, Fire will not keep in long.

I am sensible, that large *Bellows* have sometimes been made Use of for this Purpose; but they require a much greater Power to produce the same Effect, and cannot have the Advantage of being immediately changed from *Forcing* to *Sucking*; neither are they so cheap as the proposed Engine, which may be all made of Wood except the *Crank*, which must be of Iron, and the *Barrels* of very thin Copper.

Boston, July 19. 1729.

IV. **M**R Adams and his Servant being employed to repair a Pump in this Place, about six o'Clock this Afternoon uncovered the Well; upon which he immediately attempted to go down, by Means only of a single Rope; but had not descended above five or six Feet, before he was rendered incapable of sustaining his Weight, and without speaking, or any Signals of Distress slipped down suddenly to the upper Part of the Joint of the Pump; where being supported about a Minute, fetching his Breath in a very distressed Manner, he fell to the Bottom, which was about eight or ten Feet lower, and covered with but a very few Inches of Water, without discovering any Signs of Life. Hereupon his Servant (*Thomas Reardon*) with great Precipitation took the Rope in his Hand, in order to descend to the Relief of his Master; but at the same Distance from the Top, met with the same fatal Interruption; and without discovering any Signs of Distress, was heard to fall to the Bottom.

*An Account of some of the Effects and Properties of Damps, by Mr Isaac Greenwood, Prof. Math. at Cambridge, New-England. No. 411. p. 184.*

The Workmen above prepared a *Third* with a Tackle about his Waste. Upon his Descent he was rendered Speechless, and made no



Signs at all, though he had agreed to it; whereupon being raised from the Well, he was thought to have the Image of Death impressed upon him; but upon the Use of proper Means was soon recovered without remembering any thing particularly that had passed.

Some Hours after this the other Bodies were taken up; but, as we had before been well assured it would be, with all the Marks of a violent Death upon them.

There was nothing particular relating to this Well, excepting that it was nearly situated to the Town-Dock, the *Reservoir* of all the Dregs of the Neighbouring Streets; and is about 30 Feet deep, which in this Place is so considerable, that it is lower than the Surface of the Water at the greatest Ebb. There had not been an *Air-Tube*, or Passage for the external Air to communicate with it for some considerable Time.

This Evening several Trials were made on *descending Lights*; particularly, by letting down *lighted Candles* uncovered, others inclosed in Lanthorns, and others with the Lanthorn placed in a Pail; but in all these Endeavours it was observed, that whatsoever the Circumstances of the descending Light were, it never reached above six Feet.

July 20. I repeated this Evening such Experiments in the *Damp* as related to *Flame*, and found the Effect much the same as before; viz. in about 6 Feet below the Top of the Well, the Flame would grow dim, and if not immediately raised, would change to a bluish Colour, and become more and more contracted or diminished, till in about a Minute's Time it would be totally extinguished, without any Remains or Stench accompanying the Wick. In these Experiments I particularly observed, that the *Flame* in all its Changes still continued its pyramidical Figure; nor did a quicker or slower Descent make any Alteration in these Circumstances. One Experiment was very particular, relating to the Flame of a Candle. We took a common Pail, and having fixed a Candle to the Bottom thereof, erect about 8 Inches long, we poured as much hot Water into the Pail as reached within a quarter of an Inch of the Blaze of the Candle. Then having carefully lowered the Pail down the Well, the Flame, notwithstanding it was defended by the reeking Steams of the hot Water, went out at the same Depth, and in the same Time as it did before. After this we immersed burning Coals, flaming Brimstone, and lighted Matches, all which were extinguished with very little Difference as to the Time, or other Circumstance.

Two Experiments were made relating to *Animal Life*. A large *Kitling* was very much affected in about a Minute's Time; and after three Minutes was rendered so weak, that after she was taken out, she could not sustain her Weight on her Legs. Being at length pretty well recovered, we carefully bound her up in a Silk Handkerchief, that she might be the more easily suspended; and having let her  
down.



down about 16 or 18 Feet, in three Minutes she was affected in the like Manner as before, making a very distressed Noise, and in about five Minutes was in such extraordinary Convulsions as rendered the Sight not a little disagreeable; but in these Throws she disengaged herself from the Handkerchief, falling to the Bottom, without making any Efforts to swim; whence we concluded they were the last Struggles for Life, in which she broke loose.

We tried the same fatal Experiment upon a small Bird, which being suspended in the *Damp* about three Minutes, was found entirely senseless, and according to all Appearance past Recovery. Upon taking it in my Hand, I found it was very cold, nor had it the least Motion that I could discover; however, keeping of it close between my Hands, which were pretty warm, in about a Minute I felt a small Palpitation, which presently increased to a stronger Pulse, till in about six or seven Minutes the Bird was restored to a perfect and uninterrupted Respiration. About half an Hour after this, we again put the Bird into the *Damp*, and continued it there about five Minutes, after which we found it past Recovery.

July 21. I repeated several of the Experiments relating to Lights and Flame, which succeeded with very little, if any Alteration, as before; which we looked upon as an undoubted Confirmation of the Continuance of the *Damp*. Whereupon we proceeded; first, to examine the Elasticity of the Air in the Well, by letting down a small Bell, the Sound of which was as distinct and loud, as in any ordinary Well of the same Depth.

Then to discover the Degree of Moisture, we took a large Sponge a little wet, which with the *Silk String*, whereby we let it down, weighed 278 Grains. This being suspended in the *Damp*, upwards of five Minutes, and then raised, was carefully weighed, and found to be of the same Weight precisely. After this we dried the *Sponge*, which then weighed but 261 Grains, and having applied it to the *Damp* for the Space of ten Minutes, we found also, that it had not gained the least Part that could be perceived in its Weight. Also, a large Bundle of *Catgut*, weighing two Ounces fifteen Penny-weight ten Grains, acquired not the least Augmentation thereto, by being suspended for a very considerable Time.

To these Experiments we added one upon the *Hydrostatical Balance*, in order to determine whether there was any extraordinary Difference as to the Density, or Specific Gravity of common, and this vitiated Air. The *Balance* we made use of was very large, and accurately poized, and the *Solid*, which was a Globe, was four Inches eight tenths in Diameter. This with its String weighed in the Air seven Ounces six Penny-weight. And after we had immersed it in the *Damp*, it lost nothing of its Weight, being then in *Æquilibrio* to so great a Degree of Exactness that half a Grain would over-ponderate on either Side.

This.



*Of the Effects and Properties of Damps.*

This *Damp* abated more and more by being exposed to the Air, till on *July* the 25th, Persons were let down to the Bottom without any Inconvenience.

The other Instance is of a very sudden Subterraneous Vapour, on *May* 9, 1729, in a Well in *School-house-Street, Boston*.

This Well had been opened for some considerable Time; and not only enlarged in it's Diameter, but sunk fourteen or fifteen Feet deeper. Hereupon Mr *Rennief*, and a young Man whose Name was *Russel*, undertook to lay the Stones. They had been employed all the Day, till about six o'Clock in the Afternoon, when *Rennief* perceived a very unusual Stench, of which he first upbraided his Partner as an Act of Indecency, till by the extraordinary Increase thereof, he was apprehensive of some greater Danger. *Russel* was hitherto unsensible thereof, but perceiving his Partner's Visage to change to a very uncommon Degree, called up for Relief; at which Instant, as he afterwards expressed himself, *He first perceived a very strong noisome Smell, resembling rotten Fish, which on a sudden seized his Senses, and rendered him unable to sustain his Weight.* *Rennief* had immediately closed his Mouth and Nostrils with his Hand; and when the Bucket was lowered with a third Person for their Relief, assisted in getting *Russel* into it. As the Bucket was raising, *Russel* was taken with very unusual and extraordinary Fits; and when he was laid upon the Ground, till *Rennief* was taken out, could scarce be kept still by the united Strength of three or four Persons; but bounding and writhing his Body, like a Fish newly taken from the Water. *Rennief* was affected only with fainting Fits. After three Hours *Russel* recovered of these extraordinary Convulsions, but was disordered in his Brain during the whole Night; and though *Rennief* was sooner relieved of his Fits, he continued extreamly disordered for a longer Time. It was thought remarkable, that neither of them was affected with either Vomiting or Purging.

This Accident happened on *Friday*, and on the *Monday* they were both restored to perfect Health. The Well continued infected for a very little while, and when on the *Monday* following some other Workmen renewed the Work, there was nothing Noisome that could be perceived.

I cannot call to Mind, that there is any Instance of such a transient Vapour or Damp recorded in the *Philosophical Transactions*; and must confess I am at a Loss how to account for it. Should there be Subterraneous Exhalations which, like the Clouds or Wind in the Atmosphere, shifted from one Place to another, it might be of great Importance to observe the Particulars thereof, especially such as are *Malignant*, as this was. The Passage of this Vapour was about 25 Feet below the Surface; a Depth too great for it to affect Cellars or Vaults,



I had forgot to note, that this Part of the Town lies very high; and the Ground for about ten Feet, hard Clay, and the rest a coarse Sand and Gravel.

V. It was first taken notice of on the second of *August* last, in a *Marshy-Field* situated in the Parish of *Flinx-Hill*, about ten or twelve Miles South West of *Canterbury*.

*A Subterraneous Fire, observed in Kent, by Robert Nesbitt, M. D. No. 399. pag. 307.*

It began on the side of a little Brook near the Water, and continued to burn along it's Bank, without spreading much for some Days. Afterwards it appeared on the other side, and extended itself the space of some Acres over the Field, consuming all the Earth, where it burnt, into red Ashes quite down to the Springs; which in most places lay four Feet or more deep. On the Twenty fourth of *September* I went to see it, and found it had consumed, as well as I could guess by my Eye, about three Acres of Ground.

It then burnt in many Places, and sent forth a great Smoak and strong Smell, very like to that of a Brick Kiln. It never flamed but when the Earth was turned and stirred. For some space round where it was burning, the Ground felt hot, tho' the Grass seemed no more parched than might reasonably be expected from the Dryness and Heat of the Season. I caused it to be turned up in several Places, and found the Earth hot and wet near four Feet deep, and much hotter about two Feet than near the Surface.

When this Earth was exposed to the Air, tho' it was very moist and not hotter than you might easily bear with your Hand, the Heat increased so fast, that in a few Minutes it was all over on Fire, like *Phosphorus* made with *Alom* and *Flower*.

The Soil of the Field is of the same nature with that they make the *Turf* of in *Holland*; the Surface of it is always wet, except in extreme dry Seasons. This Year it was somewhat more parched and hard than usual.

I believe, from what has been related, it is not more difficult to account for this Fire, than for those which often happen in *Hay-ricks* when Hay is stacked before it is thoroughly made.

VI. The Thermometer used in this *Diary*, was made by Mr *Hauksbee*, in which the Freezing-Point is marked at 65 Degrees under the Point extreme Hot; but the Doctor observes, that, at *Naples*, Water will freeze when this Thermometer stands at 55 Degrees only: Which, he is of Opinion, seems to argue, that there is something else besides an intense Degree of Cold required for freezing Water; that the Air of *Naples* abounds in it, more than the Air of *London*; and that this may probably be of a saline Nature; because when we turn Water into Ice by the Help of Snow, it is necessary to mix Salt with it.

*An Eruption of Mount Vesuvius, extracted from the Meteorological Diary at Naples, communicated by Nichol. Cyrrillus, M. D. R. S. S. No. 424. pag. 336.*

*March.*



*A Shock of an Earthquake &c.*

*March* Ther. Winds.

8. 40 : 0. S. 3 Cloudy Weather ; strong South Wind. *Vesuvius* sent forth a great Smoak and Stream of Fire with hollow Rumbling.

1730.

9. 38 : 0. W. 1 The Weather cloudy. The following Night *Vesuvius* thundred as it were twice. In the Day the Windows trembled a little.

10, 11, 12. 39 : 0. S. 1 Cloudy ; Rain now and then : The Clouds hide the Smoak and Fire.

13. 41 : 1. NW. 1 Weather rather clear. The Smoak is lessened.

14. 47 : 0. N. 2 A little Rain in the Night, in the Morning Snow in the Mountains. In the Forenoon the Snow increased again. In

the Evening after Eight o'Clock the Fire arose to a vast Height, and threw huge Stones to almost half the perpendicular Height of the Mountain. Pumice Stones red hot of two or more Ounces Weight, were driven several Miles like a Shower of Hail, and frightened away the Birds. In about an Hour's time the Height of the Flame was somewhat lessened ; and through the middle of the thick Smoak Flashes of Lightning were often see.

*March* Ther. Winds.

15. 30. 0 NE. 1 Clear Weather. Thick Smoak scattered the Ashes many Miles over the Sea.

16. 48 : 0. S. 1 Clear in the Morning ; about noon cloudy, small Rain and cold. By Change of the Winds the Smoak and Ashes were carried towards the N. Clouds hide the Mountain.

17. 40 : 1. S. 1 A few thin Clouds. The Smoak turned with the Wind.

18. 40. S. SW. 1 Clear. The City was sprinkled over with small Ashes, like Kitchen Ashes, which were attracted by the Loadstone.

19. 42. 0 W. 1 A few thin Clouds.

20. 37. 0 0 Almost clear. *Vesuvius* became entirely quiet.

*A Shock of an Earthquake felt near Dartford in Kent, by the Rev. Mr Edmund Barrel, Rector of Sutton. No. 399. p. 305.*

VII. I had an Information brought to me yesterday, that the Earthquake was felt very sensibly at a Farm on a Hill called *Skeat-Hill*, which is at the West End of *Lullingstone-Park*, belonging to *Percival Hart, Esq* ; about 8 Miles South-West from *Dartford* : And the same Morning a Piece of Ground, in a Meadow in *Farningham*, about five Miles South of *Dartford*, fell in, so as to leave a Pit about 8 or 10 Feet over and near as deep ; and being on the same level with the River, it was (when seen that Morning) filled with Water, within 3 or 4 Feet of the Top ; though that Spot of Ground, was supposed



to have been as sound as any about it, Carts having many times gone over that very Place.

VIII. The Earthquake came suddenly upon us in the Night after the Lord's-Day, *Octob.* 29, 1727, between ten and eleven, in a very still and fair Evening; the Stars so bright and glittering, that many had taken great Notice of them, and one or two Persons that had been in Places subject to Earthquakes, had said transiently, that if we had been used to have them, they should expect one. This only general Symptom of it's Approach I have heard of, namely, the most serene Sky and calm Air that was ever known, not a Cloud in the Sky, nor scarce a Breath of Wind. And though this is not universally a Symptom when Earthquakes are coming on Places, yet so far as I can inform my self, it has often and for the most Part been observed. It was so in the dreadful Shake at *Jamaica* thirty odd Years ago; and a most ingenious and observing Friend of mine who had his Leg broke on the Point when it sunk, and is still living, tells me, That after that Shock, which was followed with many Tremblings and lesser Shakes while his Leg was healing, he could from Day to Day judge by the Face of the Sky and Air, whether there would be any Tremor or Jar of the Earth. If there was any Cloud hanging over the mountainous Part of the Island, there was no Shake that Day; but if all was serene and fair, he expected one, and it seldom failed. Yet it has not been found so with us, in our After-rumbles and Tremblings, which returned often for some Months after the great Shake, and at Times for nine Months after it.

*An Account of  
the late Earth-  
quake which  
happened at  
Boston in  
New-England  
by the Rev.  
Mr Benjamin  
Colman. N<sup>o</sup>.  
409. p. 124.*

The Town of *Newbury*, at the Mouth of *Merrimack* River, about forty Miles *North East* from *Boston*, is the Place that seems to have been the Center of the Shock and Shakes felt by us. There the Earth opened and threw up many Cart-loads of a fine Sand and Ashes, mixed with some small Remains of Sulphur; but so small, that taking up some of it in my Fingers, and dropping it into a Chafing-dish of bright Coals, in a dark Place, once in three Times the blue Flame of the Sulphur would plainly arise, and give a small Scent, and but a small one. By this it seems evident that it was a sulphureous Blast which burst open the Ground, and threw up the calcined bituminous Earth. The Family nearest to this Eruption, it being in that Part of the Town where the Houses lie at a Distance from each other, were in the Terrors of Death; the Roar and Shock being much more terrible upon them than upon others: And yet upon us at forty Miles Distance, and upon others at forty and forty more, it was very terrifying and astonishing.

Five or seven small Shakes were felt by us, after the first and great one, that Night and in the Morning following; but these and other following Rumbles and Tremblings, were louder and greater at *Newbury* and the adjacent Places than with us; and they felt and heard many Times when our Parts did not; but yet from Week to Week,



we and the Places about us felt and heard some of the greater Tremors, both by Day and Night.

I have received from a Reverend Minister in *Newbury* \* the following Account.

As to any previous Notices of the Approach of the Earthquake, I cannot find any thing to be depended on. The Prognostications that have been among us have all failed; such as the Brightness of the Sky beyond what was common; the twinkling of the Stars, and the like. I certainly know that we have heard the Rumbles in all Weathers, cloudy, foggy, rainy, snowy, clear, cold, hot, moderate, windy, calm, &c. indifferently; and at all Hours of Day and Night; (though by the way, we heard these Rumbles oftner in the Night during *Winter*, as I think, and since more usually in the Day) Also when the Wind has been at any Point of the Compass, and at all Times of Tide; and as to the Moon equally when she was nearer or further from her Change or Full: Neither in any particular Weather, nor on any observable Occasion were the Shocks greater, or Rumbles louder.

As to any Alterations in the Air or Water after a Shock, I could never discern any thing; particularly as to the Wind being raised after a Shock, when it was calm before, which some reported, I could never perceive the least Difference.

One Thing I may add here, very remarkable, and which may be depended on. About the Middle of *April*, that fine Sand which was thrown up in several Places in this Parish at the first great Shock, *Octob.* 29, did actually stink to a very great Degree, even so as to be more nauseous than a putrefying Corpse; yet in a very little while after it did not smell at all. How long it was before it began to stink I am not certain; I know it did not at first, and I believe it was covered with Snow till a little while before: There is nothing of Smell now. There has been no Opening of the Ground, throwing up Sand, stopping or breaking out of Springs, &c. as at first. If there had continued any sensible Evacuating of Air, or other Matter pent up in the Earth, from the Surface of the Sea or Land adjacent to us, at the Times of our many Rumbles and Tremblings, we should have discerned it before now. *Newbury* is a Spot of Ground, and so the adjacent Towns, very much inhabited and continually travelled over; and as to the Sea contiguous to these Parts, it is full of our Coasters by Day and Night; but neither on Land or Water have any sensible Eruptions or Evacuations been observed that I hear of.

P. S. *Boston Weekly News Letter*, Sept. 5, 1728. We hear from *Newbury* and *Rawley*, That they felt the Shake of the Earth on *Thursday* last about Four in the Morning, the Noise much like Thunder.

\* Mr Lowell.



IX. It was the Consequence of a very wet Season, when the Waters, that had fallen on the Up-lands, and were not carried off by Drains, soaked into the Ground in such Quantities as to form a quick Sand at some considerable Depth in the Earth (at least this is what we look on to have caused the Phænomenon) which not being able to bear the Weight upon it, broke out at the Side of the Hill, and raised the lower Parts of it; letting the Brow sink 40 or 50 Foot, as I guess. I am but a rude Designer, but can trust you so far as to give such a Sketch as I can draw; for, perhaps, you may understand me the better for it.

*An uncommon Sinking of the Ground at Lymne in Kent. Communicated in a Letter to Mr Peter Collinson, No. 405. p. 551.*

The Ground sunk in a Night, and was not perceived by the Farmer's Family till they found the Change in the Morning, by their Door-cases not suffering the Doors to open. The House is strangely rent by this Accident, and, had it not been Timber built, must have fell, (as a mighty strong Barn near it did, which was built of Stone) for one great Crack of the Earth went through the Middle of it, and split a large Kitchen Chimney from Top to Bottom.

*a b c d* the Profile of the Land.

*a* the flat Land at Bottom 3 or 4 Miles from the Sea.

*d* the flat Land at Top, stiff Ground and rocky.

\* The Place of the Farm at present, which not only sunk down from *d* 40 or 50 Foot, but was also moved somewhat towards *a*.

*b* the lower Part raised to *c*.

*Fig. 54.*

X. *John Robinson*, being Master of a small Pink-Snow, called the *Richard and Elizabeth* from *Piscataqua* in *New-England*, arrived at *Tercera*, Decemb. 10. 1720. near which Island he saw a Fire break out of the Sea. The Governor hired him to go with the said Vessel to view it, and sent on Board sixteen Sailors, and two Priests. On Sunday, the 18th of Decemb. we got under Sail at 12 o'Clock at Night, and stood from *Angras*, S. E. The next Day at two o'Clock in the Afternoon, we made an Island all Fire and Smoak: we continued our Course till the Ashes fell on our Deck like Hail or Snow all Night. We bore from it, the Fire and Smoak roared like Thunder, or great Guns. At Break of Day we stood towards it again: at 12 o'Clock we had a good Observation, two Leagues South from it. We sailed round it, and so near, that the Fire and Matter it threw out, had like to have done us Damage: In which Consternation we all betook ourselves to Prayers, being in danger of driving a shoar: then a small Gale, at S. E. sprung up, and carried us clear to our great Joy. The Breeze was accompanied with a small Shower of Rain, which caused a great Dust to fall on our Deck; with the said Breeze we stood away for *Tercera*. The Governor informed us that the Fire broke out the 20th of Nov. 1720. in the Night, and that the prodigious Noise it made, caused an Earthquake, which shattered down many Houses in the Town of *Angra*, and Places adjacent, to

*An account of a new Island lately raised out of the Sea near Tercera, by Thomas Forster, Esq; No. 372. p. 100.*



Fig. 55, 56, the great Terror of the Inhabitants. We took several Draughts of  
57, 58, 59, the Island at several Bearings in our sailing round. Prodigious Quan-  
60. tities of Pumice-Stones and half broiled Fish were found floating on  
the Sea, for many Leagues round the Island, and abundance of Sea-  
Birds hovering about it. So far the Captain.

An Acquaintance of mine informed me, that in his Passage from  
*Cadiz* to *London* (the latter end of *April* was 12 Months) he observed  
the Sea from *Cape Finisterre*, almost to the Chops of the Channel, to  
be covered with Pumice-Stones, some of which he gave me.

*An Account of  
the Body of a  
Man, found in  
a Copper-  
Mine by Adam  
Leyel, Reg.  
Colleg. Me-  
tall. Affessor.  
extracted from  
the Acta Li-  
teraria Sue-  
ciæ, Ann.  
1722. Tri-  
melt. I. No.  
384. p. 136.*

XI. Anni 1719. mense Decembri, in Wrediano puteo 82 orgyias  
profundo, in rupis ipsius confinio, sub aqua & 5 orgyiarum ruina,  
defuncti hominis corpus in conspectum venit. Utrumque crus, cum  
brachio dextro & capite, avulsa petræ moles contuderat: facies ve-  
ro, corpusque reliquum cum veste, integra plane & intacta cerneban-  
tur; habitusque totus viri, collaris fasciæ orâ extremâ, sinistræ ma-  
nus ope, os obturantis, is erat, quem Lit. A. exhibet ac demonstrat.  
Crurâ, quam gerebat, pyxis ex orichalco oblonga, pyxide vero  
tabaci condebatur frustulum, utroque illæso & integro; ductitium  
autem ferrum, quo ad pyxidem annecti operculum volvique solet,  
aqua tincta edaci vitriolo totum absumserat. Caro hominis cutisque,  
asperæ licet & duræ palpantibus viderentur, non tamen lapidis ea  
erat durities, sed corneæ aut ungulinæ, etiam specie, suppar, quippe  
quæ cultro cederet scindique posset.

Fig. 61.

Post extractum tumulo, fodinaque corpus, diligenti examinatione  
quæsitum est, ecquis esset, qui agnoscere posset defunctum, aut  
quando periisset, scire? cum *Magnus Johannis*, metallicus in *Korsgår-  
den*, probe illum a se de facie, quippe quæ lineamenta omnia illibata  
servet, agnoscere, idque coram confesso Metallico, profiteretur; sub-  
jungens etiam nomen, vocatum eum aiebat *Matthiam Israël*, alias,  
ob proceriorem paulo staturam, *Matthiam Magnum* seu *Procerum*,  
qui in *Boda Swerdsiöensis* parœciæ pago editus, operam *Jonæ Petri*  
in *Dijkarebacken* locasset. Succurrit porro *Matthiam* hunc *Israëlis*,  
postquam anno 1670, & tempore quidem autumnali, solus capsula  
vectus descendisset in fodinam, desideratum, dubioque procul ruina  
suffocatum fuisse. Dictis fidem fecere idem affirmantes *Ericus Michaë-  
lis* Prætor Metallicus, & *Ericus Petri* Restiarius. His accedebat vetu-  
la, quacum vivus adhuc *Matthias* sponsalia contraxerat, quæ, veteris  
& jam reviviscentis amoris jure, exanime corpus sibi concedendum,  
aut terræ saltem mandandum postulabat. Aderant & alii plures, il-  
lum qui agnoscerent, & narrationis hujus veritatem confirmarent.

Quadraginta novem adeo annorum spatio, ab anno videlicet 1670.  
ad annum 1719. sub terra delituerat *Matthias* hicce *Procerus*, e qua  
in lucem protractum, in perpetuam rei memoriam, vetus ædes fodi-  
næ publica excepit: in qua hodieque integer, & tam quod ad vesti-  
mentum & lintea, quam carnem, cutem, capillum, & ungues, in-  
corruptus, fœtorisque omnis expers, oculis intuentium sistitur; solo

aquæ



Fig. 40.



Fig. 41.



Fig. 42.

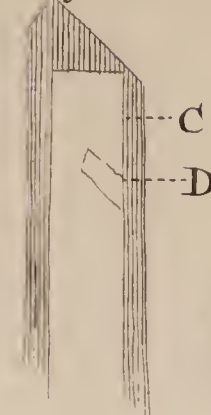


Fig. 43.

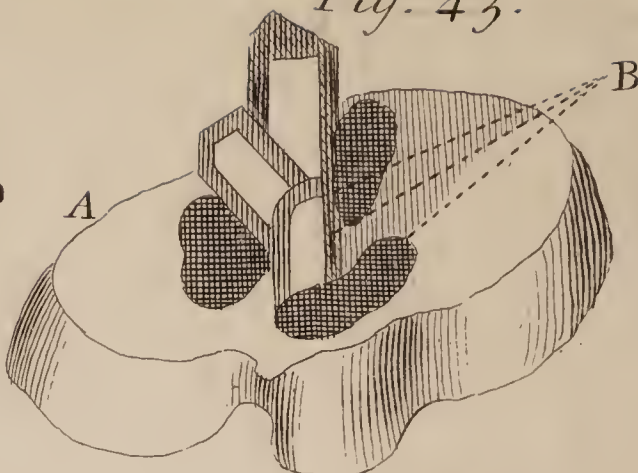


Fig. 44.

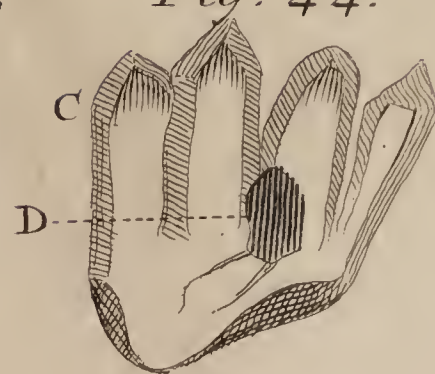


Fig. 45.

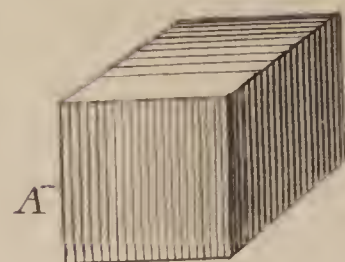


Fig. 46.

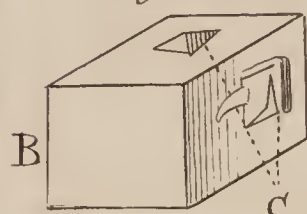


Fig. 48.



Fig. 49.

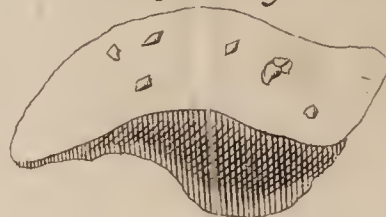


Fig. 50.

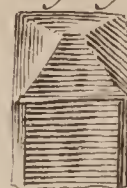


Fig. 51.



Fig. 52.



Fig. 53.

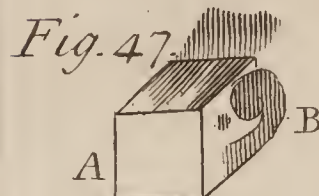
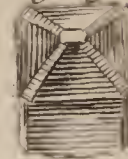


Fig. 54.



Fig. 55.



Fig. 56.



Fig. 57.



Fig. 58.



Fig. 59.



Fig. 60.



Toms sculp.

This Island is almost round and supposed to be about 2. leagues in Diameter. By good observation its Latitude is 38. 29. its Longitude. 26. 33. The Bearing and Making it in Sailing round is expressed in the Draught above.







aquæ vitriolo abundantis ministerio exsiccatus, & contra putredinis vim munitus.

Ex fideli hac certaue, quantum quidem ex loci ipsius incolis hauriri potuit, notitia haudquaquam petrificatum cadaver hoc, aut in lapidem mutatum, sed aquæ tantum vitriolo scatentis beneficio induratum esse liquet. Quid quod vitrioli naturæ & ingenio magis nil, quam ejusmodi petrificandi vis repugnat: quippe quod nil unquam in saxum convertat; tenuissimi vero vaporis vegeto motu omnia perumpat, stringat, ac a putredine interituque tueatur.

XII. Ex hominum diluvio submersorum genere paucae supersunt reliquiae. Neque ego hactenus in numerosa satis collectione plures habui quam binas dorsi vertebrae, atronitentis splendoris, petrefactas. Nunc autem, Museolo meo illatum, lapidi fissili *Oeningensi* immersum *λείψαρρον*, omni attentione dignissimum, in quo distincte cernere licet, non vagæ imaginationis simulacra, sed capitis humani à quovis alio animantium genere distinctivi partes benè multas, reapse residuas, cranii ambitum, os frontis, ossa sincipitis, occipitis, orbitam oculi, baseos cerebri & medullæ oblongatæ *λείψανα*, prominentiam anteriorem ossis occipitalis, quæ cerebelli lobos separat, colli vertebrae numero 7, partim denudatas, partim lapideo cortice tectas, & est hæc veluti orthographica sectio posterioris capitis partis.

*An Account of part of two Human Skeletons petrefied, by Joh. Jac. Scheuczer, M. D. F. R. S. No. 392. pag. 38.*

Sed inde ex quo Monumenti hujus fui potitus, novum ex dicta lapicidina adfertur prius vincens & magnitudine, & ætate, & curiositate. Adsumt nempe in dicto fissili lapide demersa, ex hominis adulti sceleto, ejusve structura anteriore, peripheria ossis frontalis, os jugale, orbitæ oculorum, cranii tabulæ cum diplôe, vestigia foraminis infraorbitalis destinati pro transitu nervorum quinti paris, reliquiae vel ipsius cerebri, vel duræ matris, ossa cribrosa & spongiosa, os vomeris nasum determinans, ossis quarti maxillaris portio, quæ genas constituit nasi reliquiae, masseteris portio, sectio orthographica transiens per apophysin condyloidem maxillæ inferioris ad angulum usque hujusdem maxillæ, vertebrae in continua serie numero 16, pleræque cum processibus transversis, claviculæ dextræ extrema portio, quæ scapulæ necitur, sinistræ media portio lapide tecta. Ex qua sceleti proportionem judico, integram hominis staturam fuisse eandem, quæ incirca mea est, 58½. pollicum Parisiensium.

XIII. 1. It is observed, that among the vast Variety of extraneous Substances lodged and found in several Layers of the Earth, at considerable Depths, where it is impossible that they should have been bred, there are not so many Productions of the Earth, as of the Sea. And again, among those which must have originally belonged to the Earth, there are many more remains of Vegetables, than of Land Animals. It appears, however, by the Histories of past Times, and the Accounts of many, both antient and modern Authors, that Bones, Teeth, nay sometimes very near entire Skeletons of Men and Animals have been dug up in all Ages of which we have Histories.

*An Account of Elephants Teeth and Bones found under Ground. By Sir Hans Sloane, Bart. No. 403. pag. 457.*



Histories, and almost in all Parts of the World, whereof those, which were the most remarkable for their unusual Size, have been also the most taken Notice of. Thus, for Instance, they have found in *Ireland*, the Horns, Bones, and almost entire Skeletons of a very large Sort of Deer, which is commonly believed to have been the Mouse-Deer, an Animal of an uncommon Size, some of which Kind are thought to be still alive in some remote and unfrequented Parts of the Continent of *America*. I shall in this Paper confine my self chiefly to the Elephant, and such Bones, *dentes exerti*, Tusks and Teeth of this Animal, as are either in my own Possession, or have been mentioned by Authors I have met with, to have been found under Ground. And first, as to those Fossile Teeth in my own Collection, which unquestionably once belonged to Elephants, I shall here produce the following.

N<sup>o</sup> 116 of my Catalogue of Quadrupeds and their Parts, is the *dens exertus* of an Elephant, which was taken up, 12 Foot deep, from among Sand, or Loom, as they were digging for Gravel by the End of *Gray's-Inn-Lane*, near *London*.

As the greatest Part of this Tooth was fallen to Pieces, nothing could be determined about it's Length, when entire. The largest Piece, and also the most entire, hath five Inches and  $\frac{8}{10}$  in Length, and 9 Inches and  $\frac{6}{10}$  in Circumference, consequently something more than 3 Inches in Diameter. This Piece belonged to the Basis, or Bottom of the Tooth; I mean, that Part by which it is articulated with the Head, as appears by a Cavity in form of a Cone, which all these Tusks have at Bottom, and which was filled, in this, with the Sand of the Gravel-pit wherein it was found.

The Condition this Tooth was found in, suggests the two following Remarks. It shews in the first Place, how far the subterraneous Steams are apt to calcine Substances of this Kind, which was done in this Tooth to such a Degree, that it was grown extream brittle, and ready to fall to Pieces, and had moreover acquired an astringent Quality common to calcined Substances of this Kind, which makes them stick pretty close, when held to the Tongue. They had altogether the same effect on the very large Skeleton, found near *Drapani* in *Sicily*, and mentioned by *Boccatus*, on that remarkable one found near *Tonna*, which hath been described by *Tentzelius*; as also on two Teeth found in *Northamptonshire*, which I shall next take into consideration. However it doth by no means follow them thence, that all Teeth and Substances of this Kind undergo the like Calcination by lying long under Ground, forasmuch as there are others, as those found in *Island*, and sent to *Thomas Bartholin*, which were turned to a perfect hard, flinty Substance. It serves, in the second Place, to ascertain the Structure of these Teeth, and consequently of Ivory in general, to be Coat upon Coat, like the Skins in an Onion, or rather the annual Circles, or Rings in Trunks of Trees. That this Tooth



is composed of different Coats, surrounding and placed upon each other, is very apparent by the largest Piece remaining. I have already *Fig. 62.*

observed that this Piece belonged to the Basis of the Tooth, and there appear in it very visible marks of nine Coats, some whereof have about one Tenth of an Inch in thickness. Towards the further End of the Tooth, where it tapers almost into a Point, these several Coats also join together into two or three, and those pretty considerably thick. With some Care these Coats might be further sub-divided in- *Fig. 63.*

to a considerable Number of other smaller ones, perhaps no thicker than a common Parchment. Farther, the very manner of it's falling to pieces is an evident Proof of it's Structure, all the Fragments being concave within, and convex without, and the Lines of Convexity and Concavity, Fragments of concentric Circles, which the several Coats composed, when entire. *Thomas Bartholin*, in his Treatise *De Unicornu* \*, takes Notice, that Part of a fossil Unicorn's Horn having been calcined by Order of *Christian IV.* King of *Denmark*, it was found to be composed, after the same manner, of thin Layers upon Layers; whence he infers, that it was not the Horn of an Animal, as was commonly pretended, but a Tooth, and namely the Tooth of a Sort of Whale in the Northern Seas, called *Narvhal*, as he had afterwards an excellent Opportunity to verify by one of these Unicorn's Horns still sticking in the Skull of the Creature, which was sent to *Wormius* by *Thorlacus Scutonium*, Bishop of *Island*. Nor is this Structure by any means to be looked upon as an Effect of the Calcination, whether brought about by the subterranean Steams, or by a chymical Trial, but is natural to the Tooth, as appears in some measure by a Piece of Ivory, marked 1181; but still more plain in another marked 731, where several of these Coats are by some Disease in the Tooth actually separated from each other, like the Leaves of a Parchment Book, the Ivory on the other Side being still firm and close. This Structure appears likewise from the Teeth of the very young Elephant which died at *London*, where the uppermost Coat, being very moist, cracked upon drying, and broke at the Top. *Fig. 64.*

N<sup>o</sup> 750, is Part of another *dens exertus*, which I had from the Reverend Mr *Morton*, who in his Natural History of *Northamptonshire* †, gives an Account of it: That Part of this Tooth, which is now in my Hands, bears again very visible Marks both of the Calcination it underwent by lying in the Earth, and of it's laminated Structure. *Fig. 65.*

N<sup>o</sup> 1185, is the *dens exertus*, or Tusk of an Elephant, remarkable for it's large Size, and for it's being so very entire. It was *Fig. 66.* found under Ground in *Siberia*. It is very entire, of a brownish Colour, and hollow at Bottom like other Elephants Teeth, one of which it plainly appears to be. From the Basis, measuring along the outward Circumference to the small End, *Fig. 67.*

\* De Unicornu observationes novæ, pag. 102

† Pag. 252.



it is 5 Foot 7 Inches long, and along the inward Circumference 4 Foot 10 Inches. Measuring from the Inside of the Basis to the small End in a streight Line, the Distance is of 3 Foot 10 Inches and a Half. At the Basis, where thickest, it measures one Foot six Inches round, and is there six Inches in Diameter: It weighs 42 Pound. The like Tusks, and other Bones of the same Animal, that is, of the Elephant, are found in sundry Parts of *Siberia* to a considerable Quantity, and the Tusks and Teeth in particular, when less corrupted, are used all over *Russia* for Ivory, *Henricus Wilhelmus Ludolfus*, in the Appendix to his *Russian Grammar* \*, mentions them among the Minerals of *Russia*, by the Name *Mammotovoikost*, and takes Notice, that the *Russians* believe them to be the Teeth and Bones of an Animal living under Ground, larger than any one of those above Ground. They use it in Physick in Lieu of, and for the same Purposes with, the Unicorn's Horn; and *Ludolfus* himself having been presented with a Piece by one of his Friends, who said, He had it from a *Russian* of great Quality, lately returned from *Siberia*, found it to be true Ivory. He adds, That the most sensible among the *Russians* affirm them to be Elephants Teeth brought thither at the Time of the Deluge. The Description of these Teeth and Bones given by *E. Ysbrants Ides* †, is still more extensive. What he observes of those Teeth that are black and broken, may serve as a Comment to the following Passage of *Pliny* ‖: *Theophrastus autor est, & ebur fossile candido & nigro colore inveniri, & ossa è terra nasci, inveniri que lapides osseos.* *Lawrence Lang*, in the Journal of his Travels to *China*, whither he went with Dispatches from His *Czarish* Majesty in 1715, takes Notice of these Bones \*\*, as being found about the River *Jenisei*, and towards *Mangasea*, along the Banks, and in the Hollows occasioned by the Fall of the Earth. He calls them *Maman-bones*, and informs us, that some of the Inhabitants are of Opinion, that they are no real Bones, Teeth, &c. but a Sort of *Cornu Fossile*, that grows in the Earth, and that others will have them to be the Bones of the *Behemoth* mentioned in the fortieth Chapter of *Job*, the Description whereof they pretend fits the Nature of the Beast, whose Bones and Teeth they are imagined to be, those supposed Words, in particular, that he is caught with his own Eyes, agreeing with the *Siberian* Tradition, that the *Maman* Beast dies upon coming to Light. The same Author affirms, from the Report, as he says, of credible People, That there have been sometimes found Horns, Jaw-bones and Ribs, with fresh Flesh and Blood sticking to them. The same is confirmed by *John Bernard Muller*, in his Account of the *Ostiacks* ††, who adds, That the Horns in particular have been found sometimes all bloody at

\* Pag. 92.

† In his Travels from *Mosco* to *China*.

‖ Lib. xxxvi. cap. 18.

\*\* Present State of *Russia*, Vol. II. pag. 14.

†† Ibid. pag. 52.



Fig. 61.

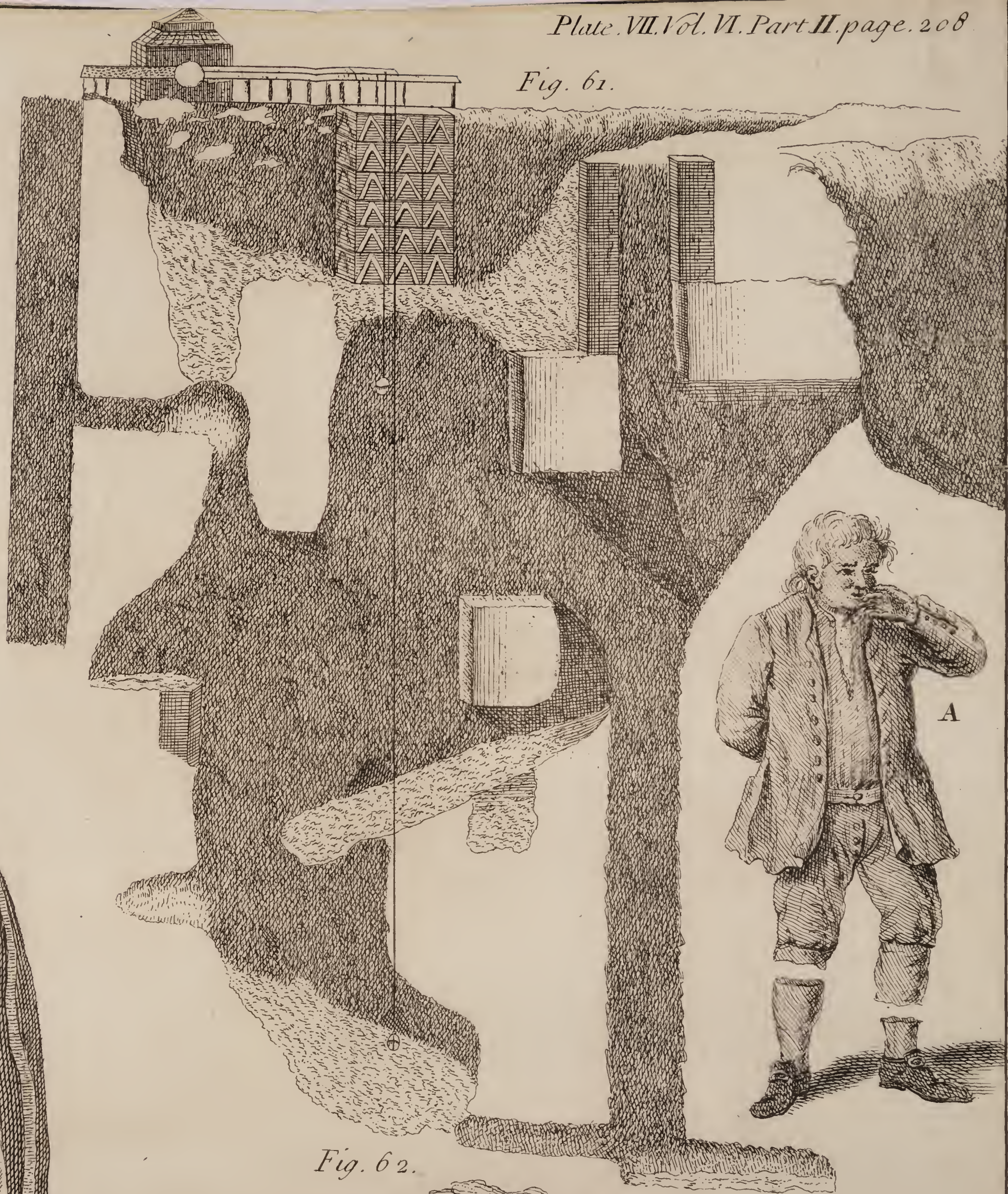


Fig. 63.

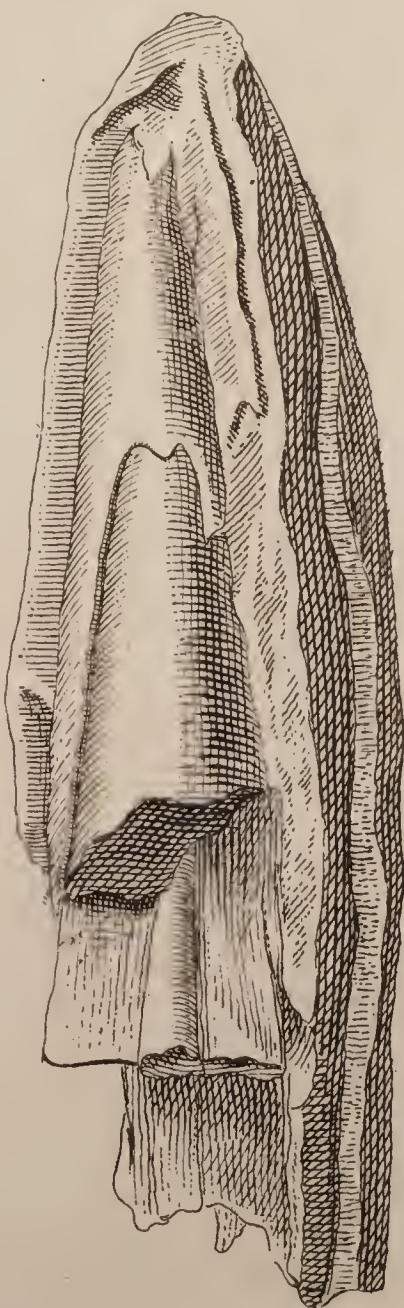


Fig. 62.









the broken End, which is generally hollow, and filled with a Matter like concreted Blood; that they find, together with these Teeth, or Horns, as he calls them, the Skull and Jaw-bones with the Grinders still sticking in them, all of a monstrous Size; and that he himself, with some of his Friends, hath seen a Grinder weighing four and twenty Pounds, and better; that the Inhabitants make divers Sort of Works of these Teeth, and that they are mostly to be met with in the coldest Places of *Siberia*, as for Instance, *Jakutsky*, *Beresowa*, *Mangasea*, and *Obder*. He likewise gives the Description of one of these Animals, from the Accounts of several Persons, who assured him, That they had seen them in the Caverns of the high Mountains beyond *Beresowa*: But as this Description hath very much the Face of a Fable, I forbear inserting it here. The Author of the *Present State of Russia* \* observes, that some of the *Swedish* Prisoners banished into *Siberia*, got their Livelihood by turning Snuff-boxes out of these Teeth; and in another Place † he mentions them among the *Siberian* Commodities, of which the Czar hath the Monopoly.

The Accounts which I have hitherto given of these *Maman*-bones and Teeth, or at least their most essential Parts, are confirmed by a Letter of *Basilus Tatishow*, Director General of the Mines in *Siberia*, and Counsellor of the Czar's Metallic Council, written to the Learned *Ericus Benzelius*, now Bishop of *Gothenburg*, and printed in the *Acta Literaria Sueciæ* (M. DCC. XXV. Trimestre secundum, pag. 36.) wherein he mentions the following Pieces he had in his own Possession: A large Horn, as he calls it, or Tooth, weighing 183 Pounds, which he had the Honour to present to his *Czarish* Majesty, and is now kept in the Czar's Collection of Curiosities at *Petersburg*; another large Horn, which he presented to the Imperial Academy at *Petersburg*; another still larger than either of these two, which he caused to be cut, and carved himself several Things of it, the Ivory being very good; Part of the Skull, corrupted by having lain in the Ground, and so large, that it seemed to him to be of the same Size with the Skull of a great Elephant; the Forehead in particular was very thick, and had an Excrescence on each Side, where the Horns usually stick to it, which Excrescence however, as the Author observes, was so small, as to make him doubtful, whether or no there was ever any Horns stuck to them. The Cavity, wherein the Brain was lodged, was exceedingly small in Proportion to the Bulk of the Skull. He had found also a spongy Bone of a Foot and a Half in Length, and three Inches in Breadth, sticking to the Skull, and of a conical Figure, whence he conjectured, that it served to support one of the Horns, which is observed also in other Animals that bear Horns; Lastly a Grinder, which had ten Inches in Length, and six in Breadth, besides several of the Ribs, Shank-bones, and other Bones found from Time to Time, which the Author forbore mentioning. The same

\* Vol. I. pag. 12.

† Pag. 78.



## Elephants Teeth and Bones found under Ground.

Author hath taken no small Pains to inquire into the true State of those Pits and Hollows which the Pagan Inhabitants of *Siberia* say, these Animals make when they walk under Ground, and found that they were nothing but Caverns, such as are common in other mountainous Countries, and are owing to the Force of subterranean Rivers and Cataracts, which at last eat through and undermine the Places where they pass, so as to make the Ground above them give Way and sink in. This is what I found remarkable in this Letter of Mr *Tatishchow*. I cannot forbear adding, that although the Author hath left the grand Question about the Origin of these Bones undetermined, yet his Observations seem to me to contribute very much to establish the Opinion above related, that these Bones are the Bones, and the Horns, as he calls them, the Tusks of Elephants drowned in the universal Deluge. It is to be hoped, that this Matter will one Time or other be set into a still clearer Light, particularly after the Order his late *Czarish* Majesty was pleased to give to the Governor-General of *Siberia*, to spare no Care nor Cost to find a whole Skeleton of this Animal, and to send it to *Tatishchow*.

Before I proceed farther, I will beg Leave to add one Observation of *Cornelius le Brun*, who in his Travels through *Russia* to the *East-Indies*, tells us, That in the Neighbourhood of *Veronitz* they had found several Elephants Teeth on the Surface of the Ground, which no Body could tell how they came thither, and that the Czar's Opinion about them was, that *Alexander* the Great, when he passed the *Tanais*, or *Don*, advanced as far as *Kostinka*, a small Town eight Wersts from thence, and that probably some of his Elephants died there, of which those Teeth were the Remains.

N<sup>o</sup> 764 of my Collection, is one of the Grinders of an Elephant, which was likewise found in *Northamptonshire*, and described by Mr *Morton* \*. It is very visible, that this Grinder also, by lying in the Earth, hath undergone the same Alteration with the Tusk above described found in *Bowdon-parva* Field.

N<sup>o</sup> 119, and 120, of my Catalogue, are two Pieces of another large Grinder, very probably of an Elephant too, turned to a very hard, stony, and almost metallic Substance.

N<sup>o</sup> 121 is a Piece of the *Molaris*, or Grinder of an Elephant, where the undulated Lamellæ are set very close to each other.

N<sup>o</sup> 122 is a Piece of another Grinder, perhaps of an Elephant. It hath very apparent Marks of being fossile, as well as the preceeding, and is farther remarkable, for that a petrifying Substance being got between the Lamellæ hath very considerably separated and divided them from each other, in such a Manner, that they appear to have been set very loose.

N<sup>o</sup> 427, of my Collection of Quadrupeds and their Parts, is Part of an Elephant's Skull which was found at *Gloucester* after the

\* Nat. Hist. of Northampt. C. iii. §. cxxxv. pag. 252.



Fig. 64.

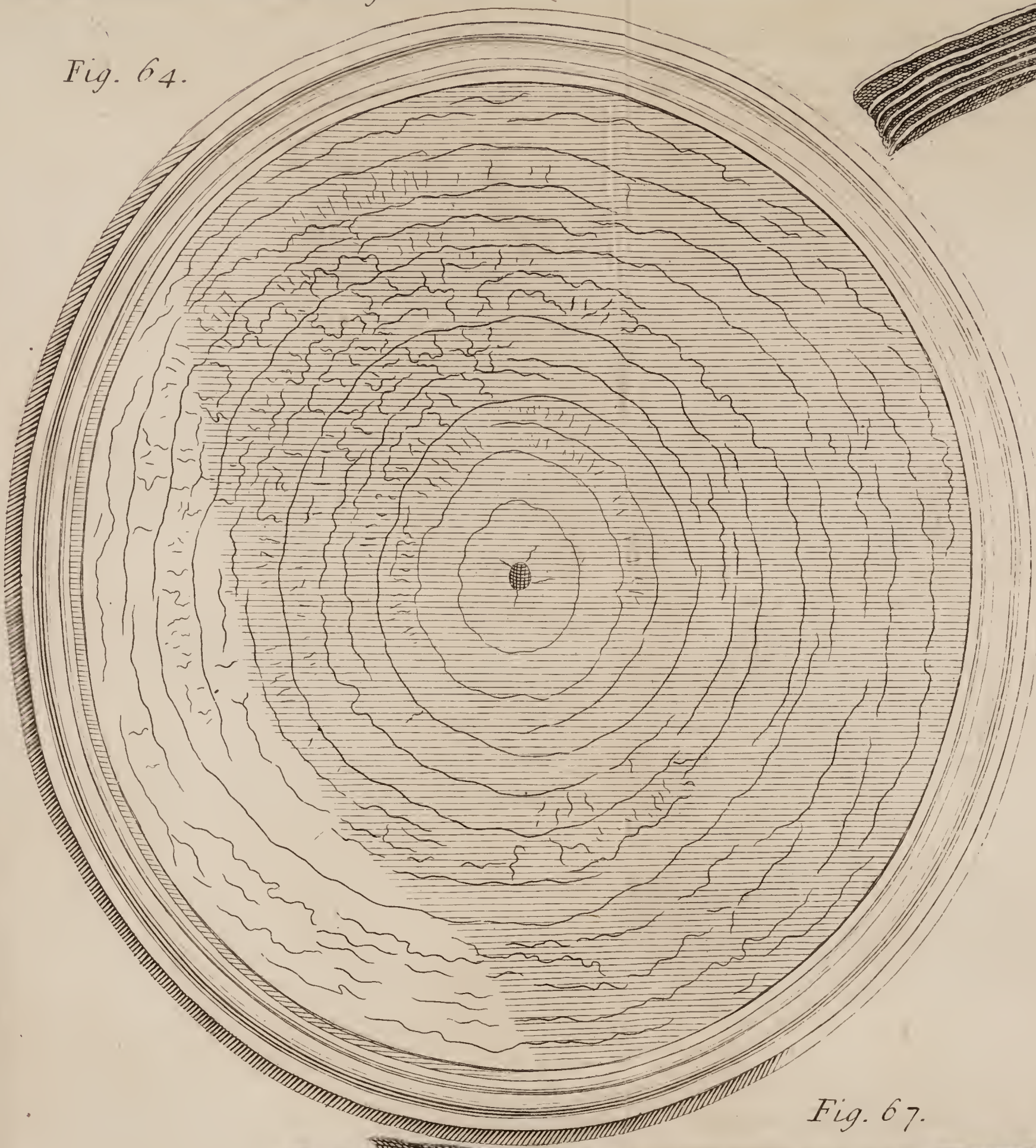


Fig. 65.



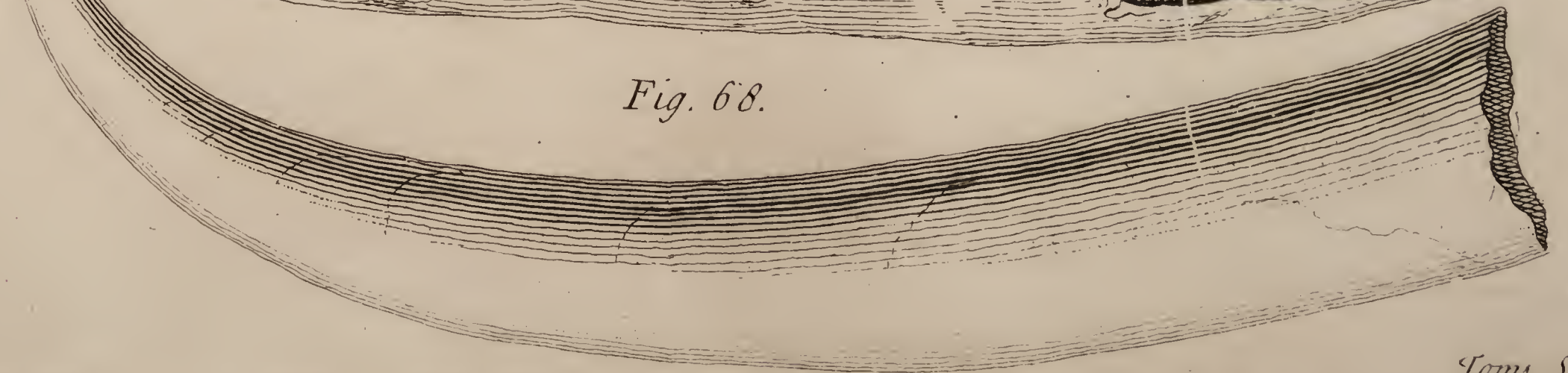
Fig. 66.



Fig. 67.



Fig. 68.









Year 1630, together with some large Teeth, some five, others seven Inches in Compass, according to a short Inscription written upon this very Piece.

2. I proceed now to the Second Part of this Discourse, wherein I propose to offer some Remarks on divers Accounts of Bones and Teeth found under Ground, which I met with in several antient and modern Authors, and which will give me an Opportunity of examining into the Skeletons, and Parts of Skeletons, which are shewn up and down as undeniable Monuments of the Existence of Giants.

*Of Fossile  
Teeth and  
Bones of Ele-  
phants. Part  
the Second.  
By the same,  
No. 404. p.  
497.*

And first, as many of those Bones and Teeth, which are kept and shewn about for Bones and Teeth of Giants, have been found, upon a more accurate Inspection, to be only the Bones and Teeth of Elephants or Whales, it may from thence very probably be inferred, that others also, which for want of a sufficient Description cannot be accurately enough accounted for, must have belonged either to these, or else some other large Animal. Thus the Fore fin of a Whale, stripped of it's Webb and Skin, was not long ago publickly shewn for the Bones of a Giant's Hand; and I have in my own Possession (N<sup>o</sup> 1027) the Vertebra of the Loin of a large Whale, which was brought me from *Oxfordshire*, where I was assured it was found under Ground, and afterwards made Use of for a Stool to sit on. Now if a Computation had been made from the Proportion of this Vertebra to that of the other Parts of the Skeleton, and all had been supposed to have belonged to a Man, such a Skeleton would have exceeded in Measure, all those fabulous Skeletons of Giants mentioned by Authors.

*Fig. 69.*

I cannot forbear on this Occasion to observe, that it would be an Object well worthy the Inquiries of ingenious Anatomists, to examine, with more Accuracy than hath been hitherto done, what Proportions the Skeletons and Parts of Skeletons of Men and Animals bear to each other, with Regard either to the Size, or Figure, or Structure, or any other Quality. This would doubtless lead us into many Discoveries, and is besides one of those Things, which seem to be wanting to make Anatomy a Science still more perfect and compleat. The very Vertebra I speak of may serve to shew the Usefulness of such Observations. It differs in many Things from the Vertebrae of Men and Land-animals, as do the Vertebrae of Whales and the Fishes of the cetaceous Kind in general; and it is a very easy Matter to distinguish them from each other. The Body of the Vertebra is considerably larger in Proportion, and also lighter and more porous. The transverse Processes arise from the Middle of it on each Side. The oblique descending Processes are altogether wanting; and the Arch, or Foramen, which the spinal Marrow passes through, is made up by the spinal Process and the oblique ascending ones only: The Body of the Vertebra is very rough and uneven on each End, full of small Holes and Eminences, which receive the Holes and



Fig. 70, 71. Eminences of a round Bone, or Plate, which answers to the Epiphysis in a human Vertebra, whereof there are two between each Vertebra, joined together by an intermediate strong and pretty thick Cartilage, probably to facilitate the Motion, and particularly the Flexion of these Animals in the Sea. But to return from this short Digression.

There are many Skeletons, that were from Time to Time found under Ground, and are mentioned by the Authors, who speak of them, as Skeletons of Giants, and undeniable Monuments of their Existence, which, as I have already observed, I should rather take to be the Skeletons of Elephants, Whales, or some other huge Land or Sea-Animal. Of this Kind seem to be the pretended Skeletons of Giants of twelve, twenty, and thirty Cubits in Height mentioned by *Philostratus* \*: The Skeleton of six and forty Cubits in Height, which according to *Pliny* † was found in the Cavity of a Mountain in *Creta*, upon the overthrowing of that Mountain by an Earthquake: The Skeleton sixty Cubits high, which *Strabo* ‖ says, was found near *Tingis* (now *Tangier*) in *Mauritania*, and was supposed to have been the Skeleton of *Anteus*: The Skeleton of *Pallas*, as pretended, found at *Rome* in the Year 1500, which was higher than the Walls of that City: And likewise that, which *Simon Majolus* says was found in *England* in the Year 1171: *Longè ante Fulgosi sæculum* (are his Words \*\*) *annis plus trecentis, anno scilicet 1171. in Anglia, illuvione fluminis, resecta sunt humati olim Hominis ossa adhuc ordine composita: Longitudo totius Corporis inventa est longa ad pedes quinquaginta.*

There are others, the Description whereof concludes more clearly for their having once belonged to Elephants, though it could not be positively asserted, that they did. *S. Austin* ††, discoursing of the Existence and great Feats of the Giants before the Deluge, mentions in Proof of what he advances, That he himself, with several others, saw at *Utica*, upon the Sea-shore, the Grinder of a Man so large, that if it had been cut into Teeth of an ordinary Size, at least an Hundred might have been made of it. *Hieronymus Magius* ‖ ‖, although himself very much prejudiced in Favour of the Existence of Giants, yet suspects this Tooth, mentioned by *S. Austin*, to have been rather the Tooth of an Elephant, or else some huge Creature of the Sea, than that of a Man. But *Ludovicus Vives*, in his Commentaries upon that Passage of *S. Austin*, takes Notice, that in the Church of *S. Christopher* at *Hispella*, he was shewn a Tooth bigger than his Fist, which they pretended was one of the Teeth of that huge Saint, no Doubt, upon as good Ground, as that very large Shoulder-bone,

\* In suis Heroicis. † Hist. Nat. Lib. vii. cap. xvi. ‖ Lib. xvii. \*\* Dierum Canicularium Colloq. 11. pag. 36. †† De Civit. Dei. Lib. xv. cap. ix. citatus per Cassanionem & Lambecium. ‖ ‖ Miscellaneorum Lib. i. cap. ii. pag. 17.



which *Hieronymus Magius* says \*, was shewn in a Church at *Venice*, was the Shoulder-bone of *S. Christopher*.

The pretended Skeleton of a Giant, which was found near *Drapani* a Castle in *Sicily*, upon digging the Foundation of a House, and is described by *Job. Boccatus* †, is again not unlikely to have been the Skeleton of a large Elephant. For although the greatest Part of the Bones, through the Length of Time, and the Force of the subterranean Steams, were so rotten, that after their being exposed to the Air, they fell to Pieces almost upon touching, yet three of the Teeth were found entire, which weighed an hundred Ounces, and were by the Inhabitants of *Drapani* hung up in one of their Churches, to perpetuate the Memory of this Fact. They likewise found Part of the Skull capacious enough to hold some Bushels of Corn, and one of the Shank-bones, which was so large, that upon comparing it with the Shank-bone of an ordinary Man, it was judged, that this Giant whom some took to be *Erick*, others *Ethellus*, others one of the *Cyclops*, and again others the renowned *Polyphemus* himself, must have been 200 Cubits high; according to which Calculation, he is figured and represented by *F. Kircher* || as by far the largest of a whole Gradation of Giants, whom, after this, he Places in the following Order:

	Cubits.
The Giant of <i>Strabo</i> , whose Skeleton was dug up near <i>Tingis</i> in <i>Mauritania</i> , and was found to be. — — — — —	} 60 high.
<i>Pliny's</i> Giant, found in a Mountain in <i>Creta</i> : — — — — —	
The Skeleton of <i>Asterius</i> , Son of <i>Anactes</i> — — — — —	46
The Skeleton of <i>Orestes</i> , dug up by special Command of the Oracle — — — — —	10
The Giant, whose Bones were found under a large Oak, nor far from the Convent of <i>Reyden</i> in the Canton of <i>Lucern</i> in <i>Switzerland</i> . — — — — —	} 7
<i>Goliath</i> , as described in Sacred Writs — — — — —	
	9
	6½

The Case is still less doubtful with regard to those Bones, which were found in *France* in 1456, in the Reign of *Charles VII*, by the Side of a River in the Barony of *Crussolle* (afterwards erected into a County not far from *Valence*. *Johannes Marius* in *Libris de Galliarum Illustrationibus*, *Calamæus* in *suis de Biturigibus Commentarijs*, *Fulgosus* in his *Annals*, & *Job. Cassanio* of *Monstroeuil*, in his Treatise of Giants \*\*, severally take Notice of these Bones which were so large, that the whole Height of the Giant, to whom it was thought they belonged, and who was supposed to have being the Giant *Briatus*, was conjectured to have been of 15 Cubits. The Skull alone was two Cubits

\* L. C. pag. 20. 6. † *Genealogia degli Dei*. L. iv. ad fin. || *Mund. Subterr.* L. viii. Sect. 2. \*\* *Pag. 57. & seq.*



thick, and the Shoulder-bone six Cubits broad. Some time after, other Bones of this Kind were found in the same Barony near the same Place, Part of which *Cassanio* saw himself, and gives such a particular Description of one of the Teeth, as leaves little Room to doubt, but that it was the Grinder, and consequently the other Bones the Bones of an Elephant. His Words are \* *Miræ magnitudinis dentem multa ibidem conspeximus, longitudine unius pedis, pondere librarum octo; multo autem oblongior quam crassus visus est, radicesque aliquot habere quibus gingivæ inhærebat. Visa est insuper ea pars, qua cibus terebatur, aliquantulum concava, latitudine digitorum quatuor.* He adds farther, That such another Tooth was kept at *Charmes*, a neighbouring Castle, that he measured the Length of the Place, whence these Bones were dug, and found it to be nine Paces; that some Time after more Bones were discovered at the same Place, and that the Country all thereabouts was very mountainous, and such, as the Giants in all Probability delighted to dwell and command in. I have seen some of these Bones brought by a very curious *French* Merchant from this last mentioned Place, which I took to have belonged to an Elephant, by some large Cells between the Tables of the Skull, which are in the Skull of that Animal.

*Hieronymus Magius* † gives an Account of a very large Skull, eleven Spans in Circumference, and some other Bones, probably belonging to that Skull, which were dug up near *Tunis* in *Africa* by two *Spanish* Slaves, as they were ploughing in a Field. He was informed of this Matter by *Melchior Guilandinus*, who saw the Skull himself, when he had the Misfortune to be taken by the *Rovers*, and carried into Slavery to that Place in the Year 1559. I am the more inclined to believe, that this Skull and Bones was Part of the Skeleton of an Elephant, because, as I shall shew hereafter, a like large Skeleton was dug up near the same Place some Time after, which by one of the Teeth sent to *Peiresk* was made out to have been the Skeleton of an Elephant.

I now come to those Bones, Teeth and Tusks, (or Horns, as some call them) which are mentioned by Authors to have been dug up in divers Parts of the World, and have been made out by them, or do otherwise appear by their Description and Figures, indisputably to belong to the Elephant.

*Johannes Goropius Becanus* ||, notwithstanding he lived in an Age, when the Stories of Giants were very much credited, and had found their Advocates, even among Persons eminent for their Learning and Judgment; yet ventured to assert, that the Tooth, which was kept and shewn at *Antwerp*, as the Tooth of that unmercifull Giant, whose Defeat, brought about as they pretended, by *Brabo* a Son of

\* Pag. 62.

† Miscellan. Lib. i. Cap. ii. pag. 19. 6.

|| Originum Antwerpianarum Libro. ii. quem Gigantomachiam appellavit, pag. 178.



*Julius Cæsar*, and King of the *Arcadians*, was fabulouſly reputed to have given Occaſion to the building of that Caſtle and City, was nothing but the Grinder of an Elephant. However diſpleaſing this Aſſertion might be, as *Goropius* farther adds, to thoſe who are delighted with ſuch idle and ridiculous Stories, yet to the Judicious it will appear the leſs ſurprizing, on Account of what paſſed not long before he wrote this Book, when the almoſt entire Skeletons of two Elephants with the Grinders, and likewise the *dentes exerti*, or Tuſks, were found near *Wielworda*, *Vilvorden*, as they were digging a Canal from *Bruffels* to the River *Rupel*, to defend that Town and Country from the Incurſions of thoſe of *Mechlen*. *Goropius* conjectures, that theſe Elephants had been brought thither by the *Romans*, at the Time either of the Emperor *Galien*, or *Poſthumus*.

A very large Skeleton, likewise of a Giant, as pretended, was dug up near *Tunis* in *Africa* about the Year 1630, whereof one *Thomas d'Arcos*, who was then at that Place, ſent an Account, together with one of the Teeth, to the learned *Peireſk*. The Skull was ſo large, that it contained eight *Meilleroles* (a Meaſure of Wine in *Provence*) or one *Modius*, as *Gaſſendus* calls it \*, or a Pint and a Half *Paris* Meaſure. Some time after a live Elephant having been ſhewn at *Toulon* *Peireſk*, ordered that he ſhould be brought to his Country Seat, on Purpoſe to take that Opportunity to examine the Teeth of the Creature, the Impreſſions whereof he cauſed to be taken in Wax, and thereby found, that the pretended Giant's Tooth ſent him from *Tunis*, was only the Grinder of an Elephant. This is the Second large Skeleton dug up near *Tunis* in *Africa*, and it appearing plainly by the Tooth ſent to *Peireſk*, that it was the Skeleton of an Elephant, it may from thence very probably be conjectured, ſome other Circumſtances concurring, that the other alſo, which *Guilandinus* ſaw there, muſt have been rather of an Elephant, than of a Giant.

*Thomas Bartholin* † mentions the Grinder, or Maxillar-tooth of an Elephant, which was dug up in *Iſland*, and ſent to him by *Petrus Reſenius*. It was turned to a perfect ſtony Subſtance, like Flint, as was alſo the Tuſk of a *Rosmarus* dug up in the ſame Iſland.

A large Tooth, which by it's Shape appears plainly to be the Grinder of an Elephant, is deſcribed and figured by *Lambecius* ‡, who had it out of the Emperor's Library, though he could not be informed where it was found, or how it got thither. It weighed 28 Ounces, and was commonly taken to be the Tooth of a Giant. *Antonius de Pozzis*, chief Phyſician to the Emperor, in a Letter to *Lambecius* \*\*, affirms it to be an Elephant's Tooth, and conjectures, that it was dug up at *Baden*, about four Miles from *Vienna*, where, but a few

\* *Gaſſendus* in vita *Peireſk*. Lib. iv. Anno 1632.

† *Act. Medic. & Philoſoph.*

*Hafn.* Tom. I. Obſ. xlv. pag. 83.

‡ *Biblioth. Cæſar. Vindob.* L. VI. pag. 311.

\*\* *Ib.* Lib. vi. pag. 315.



Years before he wrote this Letter, they had found also the Os Tibiæ & femoris of an Elephant.

Another Tooth, probably of an Elephant too, is described and figured by *Lambecius* \*, who had it out of the Emperor's Library. It weighed 23 Ounces, and was found in the Year 1644 at *Krembs*, in the lower *Austria*, as they were increasing the Fortifications of that Place.

The Year following, when the *Swedes* came to besiege the Town of *Krembs*, a whole Skeleton of a Giant, as was pretended, was found at the Top of a neighbouring Mountain, near an old Tower. The Besiegers, in their Intrenchments there, being very much incommoded by the Water that came down from Mountains, dug a Ditch three or four Fathoms deep, to lead it another Way. It was in digging this Ditch they found the Skelton aforesaid, which was very much admired for it's unusual Size. Many of the Bones, chiefly those of the Head, fell to Pieces upon being exposed to the Air, others were broke by the Carelessness of the Workmen; some escaped entire, and were sent to learned Men in *Poland* and *Sweden*. Among these was a Shoulder-bone, with an Acetabulum in it large enough to hold a Cannon-ball. The Head, with Regard to it's Bulk, was compared to a round Table, and the Bones of the Arms (or Forelegs) as thick as a Man of an ordinary Size. One of the Grinders, weighing five Pounds, was given to the *Jesuits* at *Krembs*: Another is figured by *Happelius* (in his *Relationes Curiosæ*, Tom. iv. pag. 47, 48.) to whom I am indebted for this Account, and it appears plainly by the Figure of it, that it is an Elephant's Tooth. It weighed four Pounds three Ounces *Nuremburg* Weight.

Again, in *Lambecius* his *Bibliotheca Cæsarea Vindobonensis* †, are two Figures, and the Description of a very large Elephant's Tooth which weighed  $4\frac{1}{4}$  Pounds. It was sent from *Constantinople* to *Vienna* in 1678, and offered to be sold to the Emperor for 2000 *Rixdollars*, having been before, for it's unusual Size, and pretended great Antiquity, valued at 10,000 *Rixdollars*. They pretended that it was found near *Jerusalem*, in a satious subterranean Cavern, in the Grave of a Giant, which had the following Inscription upon it in the *Chaldaick* Language and Characters; *Here lies the Giant OG*; whence it was conjectured to have been the Tooth of *Og*, King of *Basan*, who was defeated by *Moses*, and who only remained of the Remnants of Giants; whose Bed-stead was of Iron, nine Cubits was the Length thereof, and four Cubits the Breadth of it, after the Cubit of a Man ||. As the whole Story looked very like an Imposition, the Emperor ordered, that the Tooth should be sent back again to *Constantinople*.

*Hieronimus Ambrosius Langenmantel*, a Member of the Imperial Academy of Sciences, inserted into the *Ephemerides* of that Academy

\* Ib. Lib. vi. pag. 313.

† Lib. viii. pag. 652.

|| Deuteronom. Ch. iii. v. 2.



an Abstract of a Letter to himself \*, from *Johannes Ciampina* in *Rome* concerning some very large Bones, to wit, the Shank-bone, the Shoulder-bone, and five *Vertebræ*, of the Number whereof was one of the *Vertebræ* of the Neck, which were dug up near *Vitorchiany*, in the Bishoprick of *Viterbo*, in the Year 1687. They weighed altogether upwards of 180 *Roman* Pounds, and having been compared with other the like Bones in several Collections at *Rome*, particularly the *Chisian* one, they appeared to be by far the largest. Most People took them to be the Bones of a Giant, but *Ciampina*, and some others, taking them, with more Probability, for the Bones of an Elephant, or some other large Animal, and knowing that there was in the *Medicean* Collection at *Florence* a compleat Skeleton of an Elephant, they procured a Copy of it, and found upon Comparison, the above-mentioned Bones so exactly to correspond with it, as to leave no Room to doubt, but that they had been Part of an Elephant's Skeleton.

The Skeleton of an Elephant which was dug up in a Sand-pit near *Tonna* in *Thurengen*, in 1695, is one of the most curious and also the most compleat in it's Kind, forasmuch as they found the whole Head, with four Grinders, and the two *dentes exerti*, or Tusks, the Bones of the fore and Hind-legs, one of the Shoulder-bones, the Back-bones, with the Ribs, and several of the *Vertebræ* of the Neck. But the whole hath been so accurately described by *Wilhelmus Earnestus Tentzelius* Historiographer to the Dukes of *Saxony*, in a Letter to the learned *Magliabechi*, printed in the *Philosophical Transactions* †, that it is needless to add any thing, the rather, as that Gentleman was pleased to oblige the *Royal Society* with some Pieces of the Bones of this Elephant, with Part of the Skull, wherein appeared it's Cells, some of the Grinders, and Part of the *dentes exerti*; all which being produced at a Meeting of the *Royal Society*, were found exactly agreeable to his Description, and ordered to be carefully preserved in their Repository. From the Surface of the Ground down to the Place where these Bones were found, the Disposition of the *Strata*, or Layers, was as follows: A black Soil four Foot deep, Gravel two Foot and a Half, the Middle whereof was made up of *Osteocolla*, and Stones to the Depth of two Foot, *Osteocolla* and Stones half a Foot, a sandy Clay six Foot, with about two Inches of *Osteocolla* in the Middle, *Osteocolla* and Pebbles one Foot, Gravel six Foot, a white and fine Sand, the Depth whereof was unknown, and in this the Bones were found.

In the Second Volume of Count *Marsili's Danubius*, where he treats of the Antiquities he observed along this River, there is Mention made of several Bones and Teeth of Elephants, which that inquisitive Nobleman met with in *Hungary* and *Transylvania*, and which are now

\* Decur. ii. Annus vii. s. 1688. Obs. ccxxxiv. pag. 446.

† No 234. pag. 737.



in his valuable Collection of Natural and Artificial Curiosities at *Bologna*. According to the best Information, the People of whom he had them could give him, they were found in Rivers, Lakes, and Pools. One of the *Vertebræ*, a Grinder, and a considerable Part of the *dens exertus*, or Tusk, were found in the Lake, or Pool of *Hiulca*. Two Fragments of the *Os Tibiæ*, a little corroded on the Inside, were taken out of a Pool near *Fogheras* in *Transylvania*, once the Seat of the Princes of that Country ; and the whole lower Jaw, with two Grinders as yet sticking in it, he had from some Fishermen, who found it in the standing Waters by the River *Tibiscus*, a little above *Die Romerskantz*, or the *Roman Fort*. All these the Author caused to be figured as big as the Life. I have above related the Opinion of *Goropius* about the Antiquity of those two Elephants, the Skeletons whereof were found near *Vilvorden*, which he traces no higher than the Time of the *Romans*, and their Expeditions into those Countries particularly under *Galian* and *Posthumus*. Count *Marsili* is of the same Opinion with Regard to those Bones and Teeth found by him in *Transylvania*. He takes Notice, that whosoever is acquainted with the vast Use the *Romans* made of Elephants in their military Expeditions, ought not to be surprized that there are Bones and Teeth found of them in those Northern Countries, where otherwise there cannot have been any ; and he urges, as a farther Proof of this Assertion, That they are found in Pools and Lakes, it having been the Custom of the *Romans*, to throw the Carcasses of dead Elephants into the Water, as it is still practised to this Day with the Carcasses of Horses and other beasts, to prevent the Distempers and other Inconveniences, which their Putrefaction might otherwise occasion. On the other Hand, there are many Arguments, taken from the Largeness of the Beasts, the Skeletons whereof are thus found under Ground, which sometimes far exceeds any that was, or could have been brought alive into *Europe*, from the Condition they are found in, and from the particular Disposition of the Strata above the Places where they are found, whereby it appears, almost to a Demonstration, that they must be of much greater Antiquity, and that they cannot have been buried at the Places where they are found or brought thither any otherwise, but by the Force of the Waters of an universal Deluge. To insist only upon one of these Arguments : If the Skeletons of Elephants, which are thus found under Ground, and at considerable Depths too, had been buried there either by the *Romans*, or any other Nation, the Strata above them must necessarily have been broken through and altered ; whereas on the contrary, several Observations inform us, that they were found entire, whence it evidently appears, that what is found underneath, must have been lodged there, if not before, at least at the very Time when these Strata were formed ; consequently long before the *Romans*. But there is another Argument, which seems to me to bear very hard



against the Conjectures of *Goropius* and Count *Marfili*. *Tentzelius* hath already mentioned it, and it is urged from the great Value of Ivory at all Times, and particularly among the *Romans*, which appears by many Passages in antient Authors; as for Instance, by a very remarkable one in *Pliny* \*, who takes Notice, That among the valuable Presents, which the *Ethiopians* were obliged to make to the Kings of *Persia*, by Way of a Tribute, there were twenty large Teeth (unquestionably the *dentes exerti*) of Elephants, and then adds, *Tanta ebori auctoritas erat*. Now it is to be presumed, that the *Romans* would not have neglected to take away the Teeth, and particularly the *dentes exerti* of dead Elephants, before they flung their Carcasses into the Water, whereas there hath scarce been any Skeleton, or any Part of the Skeleton of an Elephant dug up any where, but the Teeth were found along with them, and even among those figured by Count *Marfili*, there are three Grinders, and a considerable Part of one of the *dentes exerti*.

Dr *Robert Plott* in his *Natural History of Staffordshire* †, says, That he was presented by *William Leveson Gower* of *Trentham*, Esq; with the lower Jaw of some Animal, with large Teeth sticking in it, dug up in a Marle-pit in his Ground, and which upon Comparison he found exactly agreeable to the lower Jaw of the Elephant's Skull in Mr *Ashmole's Museum* at Oxford.

In the *Museum* of the *Royal Society* there are two Fossil-bones of Elephants: One was given by Sir *Thomas Brown* of *Norwich*, the other was brought from *Syria* for the *Os Tibiæ* of a Giant, but Dr *Grew* || proves by an exact Computation, that it can never have been the *Os Tibiæ* of a human Skeleton, by being full twenty times as thick, and but three times as long. It is an *English* Yard and half a Foot long, and hath a Foot in Circumference, where it is thinnest. Dr *Grew* observes, that by the Figure it appears to have belonged to the Leg, and not to the Thigh, and he conjectures the whole Elephant to have been about five Yards high.

Before I dismiss this Subject, I must beg Leave to mention a few more. *Gesner* \*\* takes Notice, that he was presented by a *Polish* Nobleman with a Tooth four times as large as that, which he figured under the Title of *Hippopotamus* in his Book *de Aquatilibus*. It was found under Ground, as they were digging for the Foundation of a House, together with a very large Horn, as they called it, which many took to be an Unicorns's Horn, but wrongly, as he, *Gesner*, thought, because of it's being too thick and too crooked. It is very probable, that this pretended Horn was the *dens exertus* of an Elephant. The same Author mentions a subterraneous Cavern near *Elbingeroda*, wherein were found the Bones and Teeth of Men and

\* Lib. xii. cap. 4. † Ch. vii. §. 78. pag. 78. || Musæum Reg. Soc. p. 32.

\*\* De Figuris Lapidum, pag. 157.



Animals so large, that it was scarce credible, that ever any of that bulky Size should have existed.

The Grinder of an Elephant, petrified, is kept in the King of Denmark's Cabinet at *Copenhagen*, as appears by the Catalogue \*, but there is no Mention made how it came thither, or where it was found.

They shew in the same Collection a large Thigh-bone, which weighs about twenty *Danish* Pounds, and is above three Foot in Length †. It is so old, according to the Author of the Catalogue, that it is almost become stony. The same Author takes Notice of another large Bone, then in the Collection of *Otho Sperling*, which weighed 25 Pounds, and was four Foot long. It was, as *Sperling* told him, found in the Year 1643 at *Bruges* in *Flanders*, near the public Prison, in Presence of *Bernard de Arauda*, and *Sperling's* Father, who saw the whole Skeleton there, which was of twenty Yards of *Brabant* in Length.

A Piece of Ivory was dug up in a Field on the River *Vistula*, about six Miles from *Warsaw*, which having been shewn at *Dantzic* to *Gabriel Rzaczynski*, Author of the *Natural History of Poland*, it seemed to him to be the *dens exertus* of an Elephant ‖.

In the Notes upon the last Edition of *Dr Herman's Cynosura Medica*, published by *Dr Boëcler* of *Strasbourg* \*\*, under the Title of *Unicornu Fossile*, there is Mention made of a remarkable Piece of Fossil Ivory, or rather of an Elephant's Tooth, in the Hands of *Jaques Samson de Rathsamhausen de Ebenweyer*, an *Alsatian* Nobleman. It was found in the *Rhine* upon one of his Estates near *Nonneville*, and was three *Paris* Foot, three Inches and a Half long: It had near a Foot at the Basis in Circumference, where thickest, and about eight Inches and a Half at the other Extremity. It was filled within with a Sort of Marle, but the outward Surface was stony in some Places, and bony in others. The bony Part scraped, or burnt, smelled like Ivory. The Scrapings boiled made a Sort of Gelly. The Author of the Notes adds, That they find Fossil Ivory in several Parts of *Europe*, particularly in the *Schwartzwald* (*Sylva Hercynia*) in *Moravia*, in *Saxony*, and near *Canstad* in the Dutchy of *Wirtemberg*.

An Account  
of the Pits for  
Fullers-Earth  
in Bedford-  
shire; by the  
Rev. Mr  
B. Holloway,  
F. R. S. No.  
379. p. 419.

XIV. I went to the *Fullers-Earth* Pits at *Wavendon* near *Woburn*, where there are several Pits now open; but, as Men were then at work only in one, and I understood the Earth was disposed in much the same Manner in all, I did not trouble my self to go down into more than that wherein they were then digging; in which I found Things disposed thus.

From the Surface, for about six Yards Depth, there are several Layers of Sands, all reddish, but some lighter coloured than others,

\* Mus. Regium. Part I. §. vii. No. 109.

† Rzaczynski Hist. Nat. Reg. Polon. pag. 2.

† Ibid. Part I. §. i. No. 73.

\*\* 1726. 4<sup>to</sup>. P. iii. pag. 133.



under which there is a thin *Stratum* of red Sand-stone, which they break through; and then for the Depth of about seven or eight Yards more, you have Sand again, and after that come to the *Fullers-Earth*; the upper Layer of which, being about a Foot deep, they call the *Cledge*; and this is by the Diggers thrown by as useless, by reason of it's too great Mixture with the neighbouring Sand, which covers, and has insinuated itself among it: After which they dig up Earth for Use, to the Depth of about eight Feet more, the Matter whereof is distinguished into several Layers, there being commonly about a Foot and an half between one horizontal Fissure and another. Of these Layers of *Fullers-Earth*, the upper Half, where the Earth breaks itself, is tinged red, as it seems by the running of Water from the sandy *Strata* above; and this Part they call the *Crop*; betwixt which and the *Cledge* above-mentioned, is a thin Layer of Matter not an Inch in Depth, in Taste, Colour, and Consistency, not unlike to *Terra Japonica*. The lower half of the Layers of *Fullers-Earth*, they call the *Wall-Earth*; this is untinged with that red above-mentioned, and seems to be the more pure and fitter for *Fulling*; and underneath all is a *Stratum* of white rough Stone, of about two Foot thick, which, if they dig through, as they very seldom do, they find Sand again, and then is an End of their Works.

One Thing is observable in the Site of this Earth, which is, that it seems to have every where a pretty equal horizontal Level; because they say, that when the Sand-Ridges at the Surface are higher, the *Fullers-Earth* lies proportionably deeper.

In these Works they seldom undermine the Ground, but as they dig away the Earth below, others are employed to dig and carry off the Surface, otherwise, the Matter above, being of so light and flitting a Nature, would fall in and endanger the Workmen: For, as was observed before, that *Stratum* of Sand-Stone, which occurs before they come to the *Fullers-Earth*, does not lie, as in Coal-Pits, immediately over the Matter they dig for, like a Cieling, but even in the midst of the superjacent *Strata* of Sand, and therefore can be no Security to them if they undermine.

The perpendicular Fissures are frequent, and the Earth in the *Strata*, besides it's apparent Distinction into Layers, like all other Kinds of Matter, by reason of it's peculiar Unctuousness, or the running of the adjacent Sand imperceptibly among it, breaks itself into Pieces of all Angles and Sizes.

For the Geographical Situation of these Pits, they are digged in that Ridge of Sand-Hills by *Woburn*; which near *Oxford* is called *Shotover*; on which lies *Newmarket-Heath* by *Cambridge*, and which extends itself from East to West, every where, at about the Distance of eight or ten Miles from the *Chiltern Hills*, which in *Cambridgeshire* are called *Gog-Magog*; in *Bucks*, and *Oxon*, the *Chiltern Hills*, from the chalky Matter, of which they chiefly consist: which two Ridges  
you



you always pass, in going from *London* into the North, North-East, or North-West Counties in the Manner I before-mentioned: After which you come into that vast Vale, which makes the greater Part of the Midland Counties of *Cambridge, Bedford, Bucks, Northampton, Oxford, and Gloucester*, and in which are the Rivers *Cam, Ouse, Nen, Avon, Isis*, and others; which I take Notice of, because it confirms what you say of the regular Disposition of the Earth into like *Strata*, or Layers of Matter, commonly through vast Tracts, and from whence I make a Question, whether *Fullers-Earth* may not probably be found in other Parts of the same Ridge of Sand-Hills, among other like Matter.

*An Account  
of the Strata  
in Coal-  
Mines, &c.  
By John Stra-  
chey, Esq;  
F. R. S. No.  
391. P. 395.*

XV. It was some Time since, that in a Letter to one of the Members of this Society, I gave an Account of the several *Strata* of Earths and Minerals, found in some of the Coal-Works in *Somersetshire*, which was printed in *Philos. Transactions*, N<sup>o</sup> 360. But there is one great Error in the Print; for whereas I said, that in those Parts they never meet with *Freestone* over the Coal; the Printer, by mistake, calls it *Firestone*; whereas *Firestone* is always found in those Mines, contrary to the Works in *Staffordshire, Newcastle, and Scotland*, where *Freestone* does, indeed, lie over the Coal. I have farther observed the *Strata* of Stone, Clay, and Marle, of the interjacent Hills, where, under the black Marle, lies a spongy yellowish Earth; all this lies above the red Soil, which I have said is generally the Surface of the Vallies, where the Coal is found. And as this red Mould on the Surface degenerates into Marle or Loom, so, towards the North-West, beyond or without the Veins of Coal, about *Winford*, in the same County, it turns to Ruddle, or Red-Okre, used chiefly for marking of Sheep, and for ground Colours or Priming, instead of *Spanish Brown*; and often counterfeits Bole Armoniac.

But as I never heard any Coal was found to the West or South of *Mendip-hills*; so *Cotswold*, to the North-East, and the Chalk-Hills of *Marlborough-Downs* and *Salisbury Plains*, seem to set Bounds to the Coal Country, to the East and South-East of which *Fig. 72.* may be supposed a Section from South-East to North-West, viz. from the Dip to the Rise; and *Fig. 73.* at right Angles, from South-West to North-East, on the Drift or Level.

I mention this by way of Correction and Addition to my former Observations of the Coal-Works in *Somersetshire*. I have since had Opportunities to be underground, and view several Coal-Works in *Scotland* and *Northumberland*, and to observe the several *Strata* there. At *Widdrington* they have four Fathom Clay, then a Seam of Coal, about six Inches thick, not worth working; then a white *Freestone*; then an hard Stone, which they call a *Whin*; then two Fathom of Clay; then a white soft Stone; and under that a Vein of Coal three Feet nine Inches thick. This is a small Coal of the same Nature, but not so good as the *Newcastle-Coal* which comes to *London Market*.

These

*Fig. 72.*

*Fig. 73.*



Fig. 69.

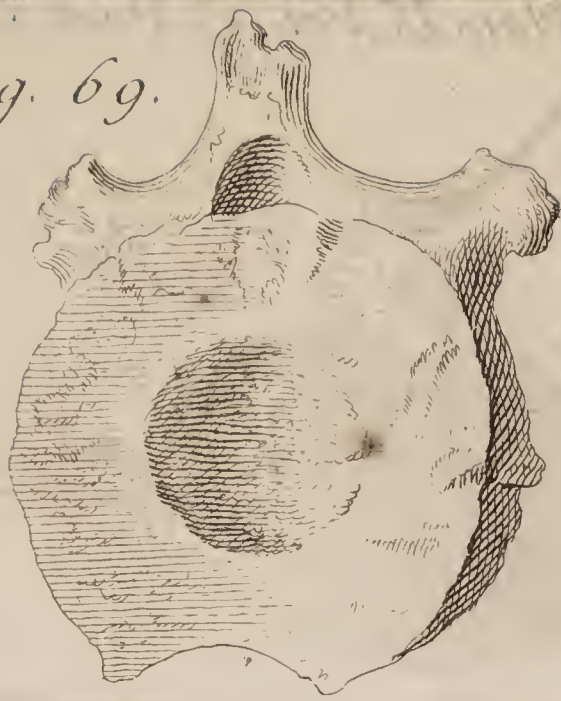


Fig. 70.

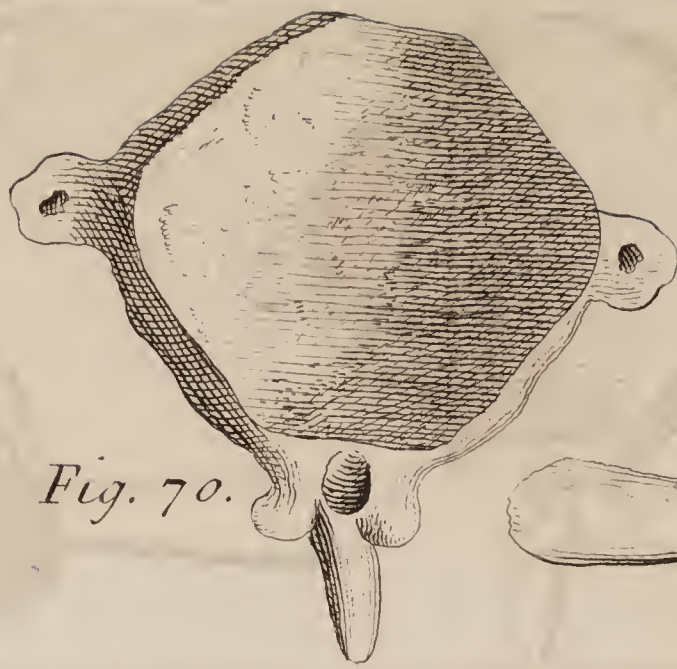
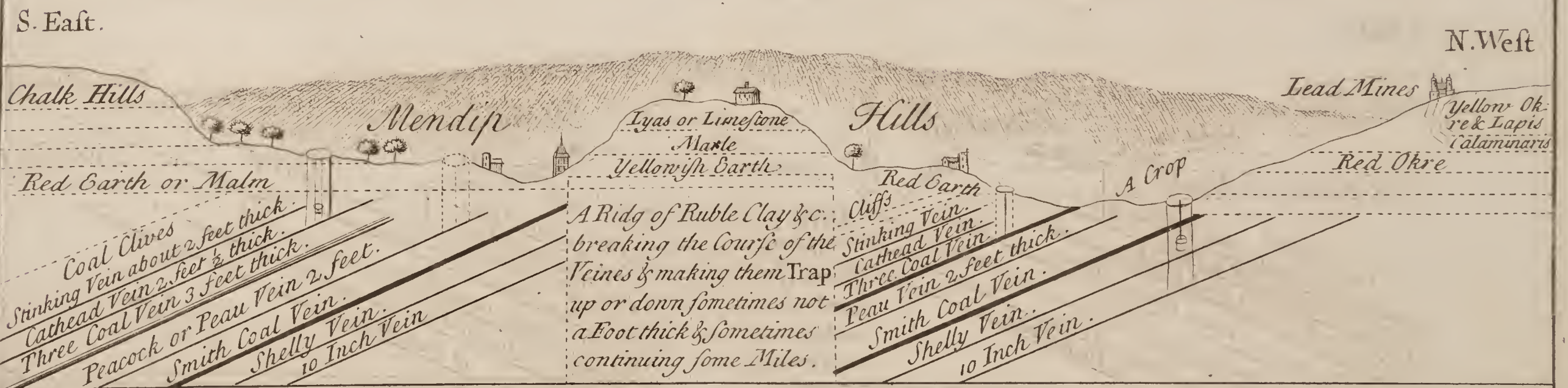


Fig. 71.



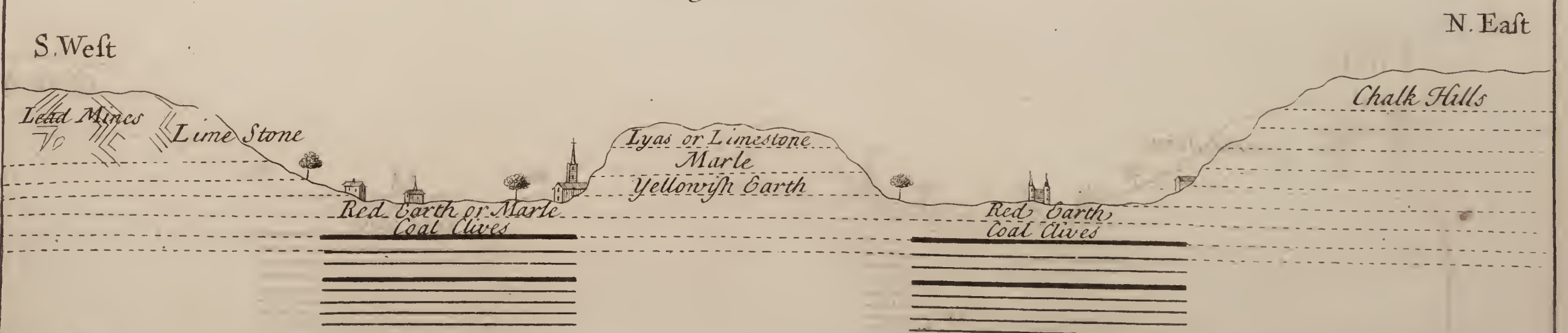
A Section of a Coal Country in Somersetshire about 20 Miles from South-East to North West

Fig: 72.



A Section of the same Country from North-East to S.W: on the Drift or Level of the Coal & at right Angles with the former.

Fig: 73.









These Veins dip to the South-East, one Yard in twenty. Near *Tranent*, in *East-Lothian* in *Scotland*, the Coal dips also to the South-East, in the same Proportion; but at *Baldoe*, in the Parish of *Campsey*, three Miles from *Kylfith*, it dips to the North-East; and at *Madestone*, near *Falkirk*, to the same Point, and in the same Proportion. The *Strata* of Earths and Minerals, at these Places, agree very near: They have, as the Ground rises or falls, one, two, or three, Fathom of Clay; then eleven Fathom of Slate, or Coal-Clives; one Fathom of Limestone; under that two Fathom of Slate, Earth and Stone; and then Coal. And all these agree in this; that the Pits generally need no Timber, and have a good Roof, which is supported by Pillars of Coal, which they leave in the working. At *Baldoe*, the Coal is commonly forty-five Inches thick; and all along for some Miles Eastward thence, on the Sides of the Hills, are Crops of Coal and Limestone; and oftentimes the Tenants spit up as much as will serve their Turn for a Winter's burning, just under the Surface; for there wants a Market, and it is scarce worth working for Sale. And to the North-West and North, in the Drift of the Coal in higher Ground, and, consequently, lying over it, there appear, in the Sides of the Hills, Seams of Spar and Lead, the Drift of which is North-East, and lies almost perpendicular; but what Obliquity there is, pitches to the South-East: At *Auchenclaugh*, six Miles East from *Kylfith*, there is a Coal eighteen Feet thick; this dips one Foot in three, and is not pursued by reason of Water; and for want of a Market, will not quit the Cost of draining. At *Madestone*, the Coal is four Feet and a half thick, above three Fathom and a half deep: They land it (as at many Coalhews in the Country) on Girls Backs. Near *Tranent* are three different Veins wrought the undermost is about eighteen Fathom from the Surface, called the *Splenty Coal*, four Feet and a Half thick; it is a hard but not large Coal, makes a clear and strong Fire; lies ten Fathom under the *main Coal*, which is nine or ten Feet thick, and comes out very large. Its Roof is of Freestone under which I walked backward and forward two Hours; but had no Opportunity to make any other Observation on the upper Vein, than that it is about four Feet thick, and neither so hard or large as the other.

As I have, in *Fig. 72* and *73*. drawn the different *Strata* (which have *Fig. 72 & 73*. come to my Observation) on a supposed Plane, as they there lie; in *Fig. 74* and *75*. I protract the same in a globular Projection, suppo- *Fig. 74 & 75*. sing the Mass of the Terraqueous Globe to consist of the foregoing, or perhaps, of ten thousand other different Minerals, all originally, whilst in a soft and fluid State, tending towards the Center. It must mechanically, and almost necessarily, follow, by the continual Revolution of the crude Mass from West to East, like the winding up of a Jack, or rolling up the Leaves of a Paper-Book, that every one of these *Strata*, though they each reach the Center, must, in some Place



Place or other, appear to the Day ; in which Case there needs no specific Gravitation to cause the lightest to be uppermost, &c. for every one in it's Turn, in some Place of the Globe or other, will be uppermost ; and, were it practicable to sink to the Center of the Earth, all the *Strata*, that are, would be found in every Part, and according to the Poet, *Ponderibus librata suis*. Add to this, that in all Places within my Knowledge, the Observation of \* another Member of the Society has held good, that the Precipices of all Hills are to the Westward, whereas the Ascent to the East is more gradual. The farther Enquiry into which I offer to the Curious, who have better Opportunity.

*An Account  
of the Strata  
met with in  
digging for  
Marle, and of  
Horns found  
under Ground  
in Ireland ;  
by Mr James  
Kelly. No.  
394. p. 122.*

XVI. Our Marle is found no where but in the Bottoms of low Boggs, where we search for it with Augres, and find it at the depth of seven, eight, or nine Foot : This in many Places occasion great Expence in draining off the Water. When we think to dig for it we chuse out six able Labourers and a Supernumerary ; then we cut up a Hole twelve Foot square ; because we judge that this Number of Men will manage that Pit in one Day, viz. two Men to dig, two Men to throw it up, and two Men to throw it by. The Supernumerary supplies Defects in every part, as will be found necessary. For the first three Foot, we meet with a fuzzy sort of Earth, that we call *Moss*, proper to make Turf for Fuel ; then we find a *Stratum* of Gravel about half a Foot ; under which, for about three Foot more, we find a more kindly Moss, that would make a more excellent Fuel : This is altogether mixt with Timber, but so rotten, that the Spade cuts it as easily as it doth the Earth : Under this, for the depth of three Inches, we find Leaves, for the most part Oaken, that appear fair to the Eye, but will not bear a Touch. This *Stratum* we find sometimes interrupted with Heaps of Seed, that seem to be Broom or Furze-Seed : Nay, in one Place I saw, what appeared to me to be Gooseberries and Currants : In other Places in the same *Stratum* we find Sea-weed, and other things as odd to be at that depth : Under this appears a *Stratum* of blue Clay, of half a Foot thick, fully mixt with Shells ; this we look upon to be good Marle, and throw it it up as such : Then appears the right Marle, commonly 2, 3, or 4 Foot deep, and in some Places much deeper, which looks like buried Lime, or the Lime that Tanners throw out of their Lime-Pits, only that it is full mixt with Shells : These are small Periwinkles, such as the Scots call *Fresh Water-Wilks* ; though there are among them abundance of round red Periwinkles, such as I have often seen thrown out on the Sea-Shore. Among this Marle, and often at the bottom of it, we find very great Horns, which we for want of another Name, call *Elk-Horns* Where they join the Head, they are thick and round ; and at that Joining there grows out a



Fig. 74.

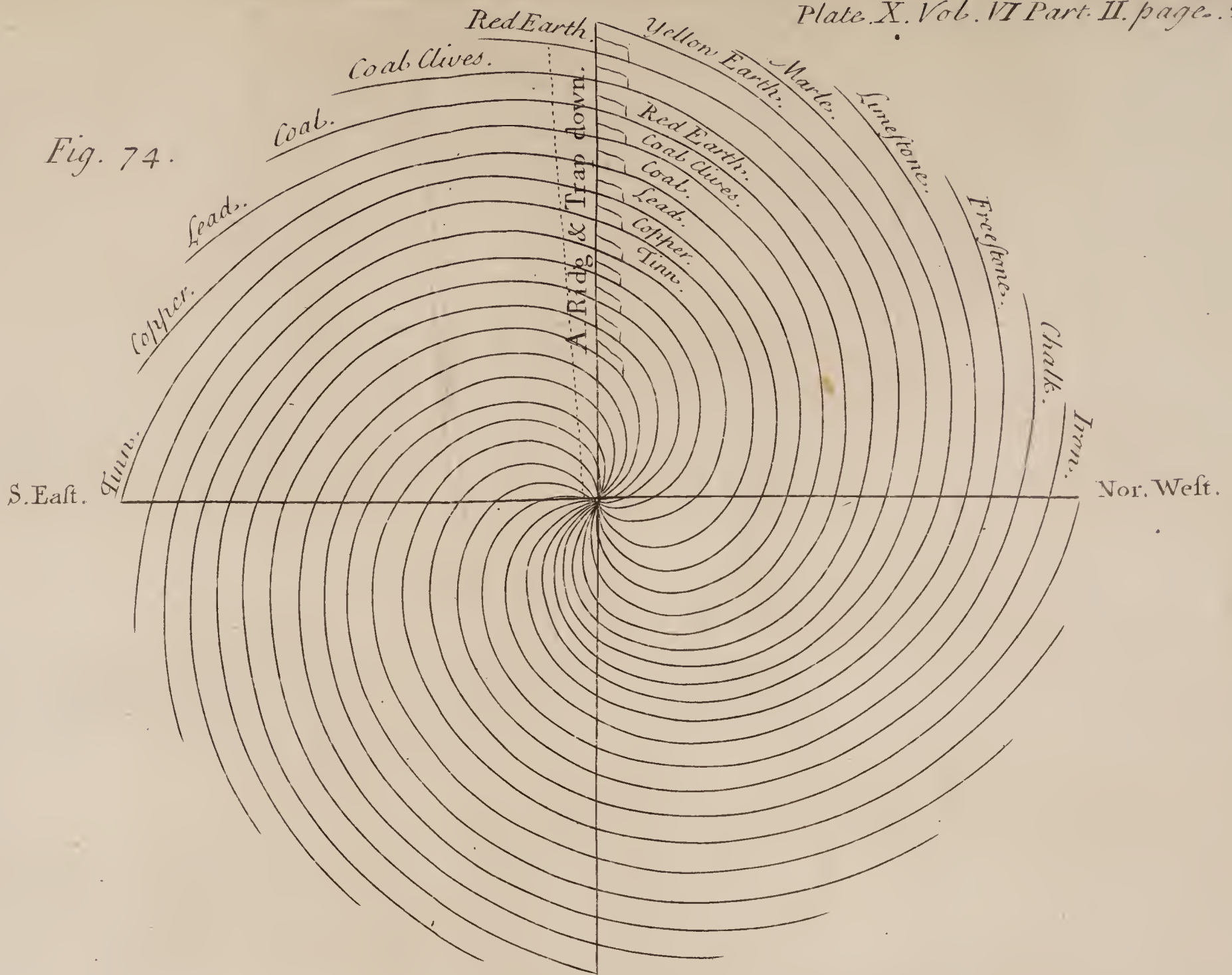
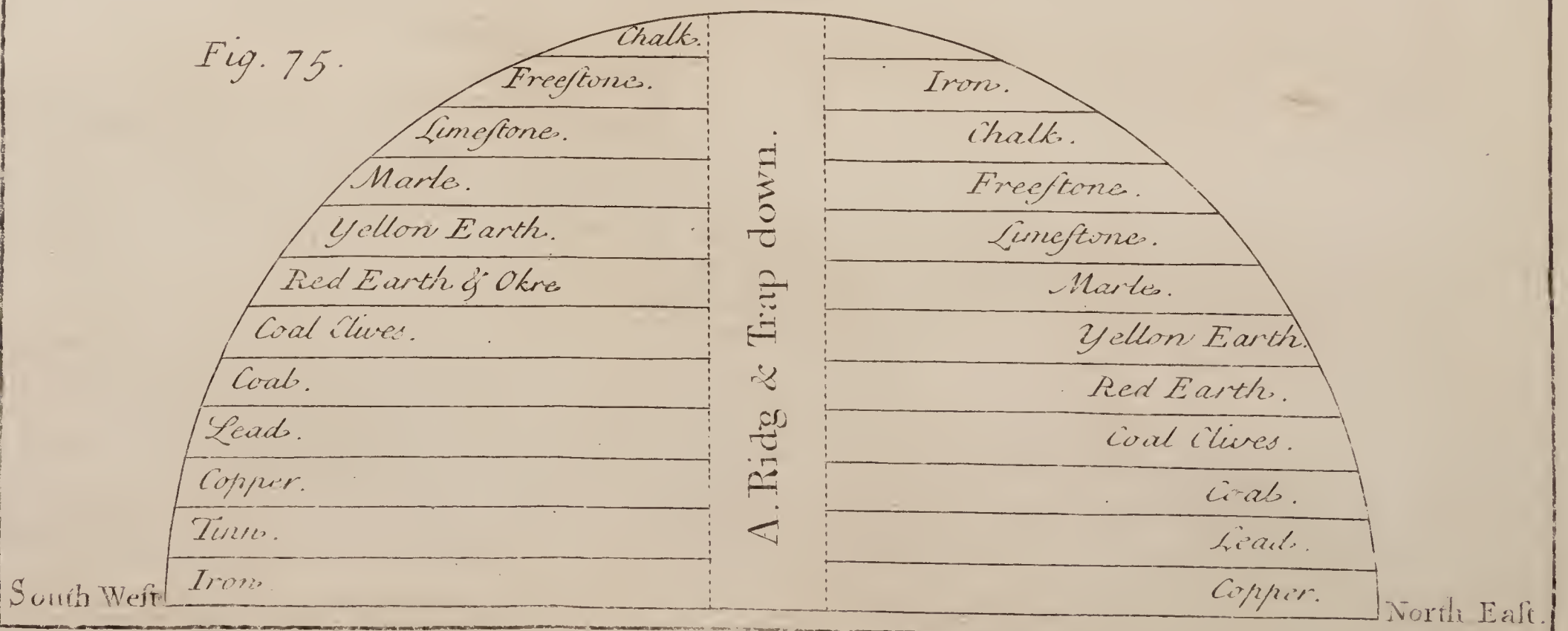


Fig. 75.









Branch of about a Foot long, that seems to have hung just over the Beast's Eyes : It grows round above this for about a Foot and some odds ; then spreads broad, which ends in Branches, long and round turning with a small Bend. The Labourers are commonly so busy, that they rarely bring them up whole ; yet I have one pretty well, of which I send you an *Icon*, done as well as I could, but not so nice as I could wish. We have also found Shanks and other Bones of these Beasts in the same Place. Fig. 76.

XVII. After they had passed the upper Turf, they came to a blue Clay, which held about 3 Foot ; then they met with a yellow, brittle Clay, very much like Ochre, used by Painters, about two Foot in Thickness ; and next with a Loam of a looser Texture, which sparkled with a kind of Talc, called by the Naturalists Selenites, and was intermixed with yellow Ochre. These Selenites, which were plentifully found shot in the Clay, were Crystals consisting of transparent, shining, brittle Flakes, some of a Rhomboidal, others of a Conical Figure, but all Hexaedra or Columns of 6 Sides. They had no sensible Taste of Salt, and the Clay in which they were found was interspersed with Veins of coloured Earth, of the Colour of Sulphur and Iron Rust. *An Account of the several Strata of Earths and Fossils found in sinking the Mineral Wells at Holt. By the Rev. Mr Lewis, Vicar of the Place. No. 403. p. 489.*

Below this, at about 10 Foot deep, they came to a Bed of Stones, of a large Size and very hard Texture, coated with Flakes of Gypsum of a white and yellowish Colour, which run through and divide them as it were by various Membranes into different Cells, all filled with hardened Loam of a grey Colour. These Stones, which were all of an oval Figure, in Shape resembling Pebbles, weighed from 10 to 60 Pound Weight, and lay all on a Level one by another in the Bed of Clay. Here the Springs come in, and below this the Clay was darker coloured, and interlaid with Small Shells of the Oyster, Escallop, and Muscle, Kind, and with a few Belemnites curiously shaped. Here they met with Stones of a very close Texture, which when washed seemed to be nothing but a Mass of Shells jumbled and embodied together. And a little lower the Clay produced some Lumps of a black, bituminous Sulphur, interlaid with some small thin Laminæ, seeming to be metalline and bright like the purest Silver : Upon firing this sulphuerous Bitumen on a red-hot Iron, it emitted a blue Flame, and strong Smell like Brimstone, but the Metal was lost. From this Account of the different Strata found in sinking these Wells, their Impregnation seems to be from Alum, Vitriol of Steel, Ochre and Sulphur, and from an accurate Mixture of all these, which no Art can imitate, it seems to derive those admirable Qualities with which it is endued.

Some Conjecture may be made of it's Nature and Qualities from the Tinctures it gives upon chymical Experiments : With astringent Drugs, as Galls, Oak-Leaves and Balauftines, it sometimes tinges Red, inclining to Purple, and sometimes will not tinge at all : With



volatile Alkalies, as Spirit of Urine, and Sal Ammon. it turns milky, with lixivate Salts, as Oil of Tartar, per Deliq. &c. it rises in a white Curdle: But acid saline Liquors, as Spirit of Salt, Nitre, &c. cause no Alteration.

A Gallon and Half of this Water being evaporated *ad Siccitatem*, the Reliquiæ weighed 3 Drams, 1 Scruple and 19 Grains, some Part of which were white, and shot into Striæ like Needles, and others into Prisms.

The neighbouring Country is chiefly a strong Clay; the Quarries produce a very hard Stone, which seems to be a Composition of Shells closely cemented and embodied together, and some Marchasites which abound with Sulphur: In sinking deep Pits they throw up Stones like Iron Oar, and covered with a shining metallic Substance and serpentine Stones, &c. and the ploughed Fields abound with Stones resembling Shells of the Escallop and Cockle Kind, striated with some Astroites, which are all strong Alkalies, and with Aqua-fortis, or Spirit of Nitre, raise a violent Ebullition.

*A Description  
of some rare  
Crystals newly  
discovered,  
by John James  
Scheuchzer  
M. D. F. R. S.  
No. 398. p.  
260.*

XVIII. In summis *Grimfulæ* jugis paucis abhinc annis detecta est, nunc exhausta, in saxo medio, crystallorum vena, quibus nec majores nec puriores, vidit fortè orbis. Maxima earum pars, ad 60 circiter centenareos, in manibus est *D. Frisching* pastoris *Hasleani*, venales omnes, sed pretio, quod ex sequentibus patebit, haud vulgari, quod fortè, præter puritatem, excusat rara magnitudo. Præcipuarum en, quam nuper ab ipso expetii possessore seriem!

Num. 1. Duorum vel 2½ centenariorum, longa 2 ped. 9½ dig. Peripheria 3 ped 7½ dig. limpidissima, hexagona. Pretium libræ 1½ Ludov. aur.

N. 2 Pondus 136 lb, longit. 2 ped. 3 dig Peripheria 2 ped. 9 dig. Purpuræ quasdam habet ad marginem, purissima cæterum. Pretium libræ 1 Ludov. aur.

N. 3. Pondus 135 lb, longit. 2 ped. 4 dig. Peripheria 3 ped. 2 dig. limpidissima, excepto apice; pretium libræ 4 Floren.

N. 4. Pondus 96 lb, longit. 2 ped. Peripheria 2 ped. 9 dig. pretium idein.

Ita descendendo pergit ad 10 librarum pondus, qualitatis, proportionis, pretii varii.

*Of the Parti-  
cles and Struc-  
ture of Dia-  
monds, by Mr  
Leeuwenhoek  
F. R. S. N<sup>o</sup>.  
374. p. 199.*

XIX. Postquam investigando compereram Metalla quædam, & ipsas etiam Arenas ex perexiguis ejusdem materiæ particulis compositas esse, meditationem meam converti ad Adamantem; scilicet num ille etiam ex istiusmodi constet particulis, quæ quidem ope microscopii conspici possint.

Igitur exiguum quendam Adamantem per microscopium contemplatus, in eâ Adamantis parte quæ polita non erat, & splendore carebat, complures particulas oculis observavi; & Adamantem ex parvis particulis compositum esse comperi. Verum cum hæc nondum mihi



mihi satisfacerent ; Adamantem in frustra confringere decrevi, ut illum in fragmentis suis considerarem.

Ergo Adamantem, malleo impositum, alio malleo semel iterumque percussi, qui sic percussus in quatuor aut quinque frustra diffiliebat. Quod cum nondum mihi satisfaceret, & Adamantem in exiguissimas miculas comminuere vellem ; frustum, quod cæteris majus erat, duplici chartâ circumvolvi, ne quæ Adamantis miculæ diffiliendo perirent.

Hic ego duritiem Adamantis admiratus sum : qui multâ vi aliquoties ictus, in quatuor tantum aut quinque frustra sine ullis miculis diffiliebat—

Posteriora ista Adamantis frustula microscopio etiam admovi : quæ cum perspecularer, pene omnia ex minutissimis particulis composita esse comperi. Cum autem frustula illa radiis solaribus objicerem : quandam quasi flammulam ex iis emicare videbam, & quidem majorem, quam unquam vidissem.

Frustulum unum oculis notabam, quod locum fracturæ suæ, planæ quidem ac quadratæ, soli directe oppositum habebat : qui locus, quantum visu dijudicabam, tribus aut quatuor pilis menti virilis latitudine respondebat.

Ex hoc Adamantis frustulo tanta ascendebat copia ardescentium flammularum, ut plures esse numero quam quadringentas judicarem. Flammularum istarum nonnullæ, sed numero paucæ, sibi erant vicinius junctæ, & reliquis majoris : unde concludebam, ipsas Adamantis particulas illic etiam aliis particulis majores esse, vel ordinatius esse dispositas.

Exinde oculos converti ad aliud Adamantis frustulum, paris circiter magnitudinis cum priori, quod radios solares itidem directe excipiebat ; & haud paucioribus exiguissimæ molis particulis constare comperiebam. Ex unâ frustuli illius parte eâque circiter dimidiatâ, species illæ ardescentium flammularum etiam exoriebantur, sed mole minores : in altera medietate flammula quædam cernebatur, assidue se mobilitans, cum continuâ quadam coruscatione, quæ speciem habebat debilioris fulgetri.

Cæterum, postquam ista Adamantis frustula radiis solaribus subduxeram, adhuc multiformes rerum species oculis meis objiciebantur. Inter alia ex singulis Adamantis particulis flammula quædam in altum emicare videbatur.

Porro, novem præterea Adamantis frustula microscopio applicata habebam : & in eorum septem particulas illas agnovi, quas speciem flammularum ejaculari dixi. In duobus aliis etiam particulas illas agnoscere poteram, ex quibus Adamantem compositum esse statui : sed illæ planitiem suam ita soli obversam habebant, ut plures eodem tempore particulas dignoscerem.

Mihi autem peramænum erat spectaculum, tot intueri imagines flammularum, quæ omnes colorem præferebant coruscum, & pleræ-



que viridentem. Istud autem insolens mihi visum est, quod ad flammularum quarundam extremitatem talis perciperetur in aëre motus ac vibratio; tanquam si flammula adeo illic debilitata foret, ut conspicua esse desineret. Præ cæteris autem admirabar, quod ex tali Adamantis particulâ circumquaque ignis exiret, debiliter rutilans, sicuti cum fulmen e longinquo coruscare videmus. Quod quidem tam crebro intuentes me accidebat, ut oculos avertere non possem, nisi jam fatigatos.

Verum tam jucundo spectaculo sæpius frui decrevi, & frustulum istud Adamantis, donec sponte a vitro: decidat, microscopio applicatum relinquere. Neque enim ope glutinosæ alicujus materiæ affixum est vitro: nisi quod vitrum, antequam illi frustum Adamantis affigerem, humore anhelitus mei irrorassem.

Cum tam grato spectaculo solus frui non vellem; quæ modo relata sunt, legenda tradidi cuidam N cui & microscopium in manus tradidi. Cumque post aliquantum moræ requirerem; nonne omnia descriptioni meæ convenire comperirent; ille prorsus convenire respondit, & admirationem suam super spectaculi insolentiâ confessus est.

Porro, cum frustulum quoddam Adamantis adhuc microscopio applicatum esset, cujus particulas, lamellarum modo sibi incumbentes, visu dignoscere poteram; haud abs re me facturum putavi, si lamellas istas delineari curarem, quæ denotantur per A B C.

Fig. 77

Deinde & aliud Adamantis fragmentum microscopio applicaveram, cujus lamellæ, invicem superstratæ, sese oculis meis distinctissime offerebant; quæ designantur per DEFGHIKLM. In hac autem figurâ particulæ illæ sive lamellæ, per FG, FH, FI, FK, & L denotatæ sunt, reliquis aliquanto crassiores esse videntur: verum istæ particulæ ex pluribus lamellis, invicem superstratis, sunt compositæ. In istâ vero fragmenti parte, quam inter DEFM exprimendam curavi, distinctissime apparent tenuissimæ lamellæ, ex quarum congerie totum Adamantem concretum esse pro certo habendum est.

Fig. 78.

Priusquam secundam iconem in chartâ exprimendam curaveram forte celebris Gemmarius, N. Verbrugge, ædes meas præteribat; quem ego ad convivendum Adamantis fragmen, sicut microscopio applicatum erat, invitavi. Ille fragmen istud non sine admiratione contemplatus, quasdam se Adamantum glebulas, quæ sibi inutiles essent, mihi missuram recepit.

Nec multo post bina mihi mittit Adamantum fragmenta: item exiguum Adamantem, ex arte quidem politum, sed sordidum, uti vocant, seu vitiosum.

Cum singula singulis microscopiis applicassem, primo fragmentum istud, quod per N O P Q R denotatum est, delineandum curavi. Lineolæ, quæ per totum hoc fragmentum excurrent, revera non sunt nisi lamellæ, ex quibus Adamantes constare modo dixi: & apertius conspiciendas se præbent ad P Q.

Fig. 79.



Cæterum ut eorum, quæ de hâc Adamantis glebulâ, sive frustulo, jam dixi, clarior atque distinctior sit perceptio; frustulum istud eâdem prorsus magnitudine exprimi jussi, quam nudo delineatoris oculo, sine microscopii ope, offerebat: quæ vera frustuli magnitudo, exhibetur inter S T. Istud autem tantillum frustulum ex tam multis *Fig. 80.* tamque exiguis particulis compositum est; ut qui non viderit, capere haud possit.

In altero Adamantis fragmento, quod ejusdem propemodum magnitudinis erat, lamellæ dignosci poterant: & pars illius circiter quinta constabat quinquangulo tam polito, tamquam si ex arte lævigatum fuisset, nisi quod illi affixus esset perexiguus Adamas, qui circiter quartam quinquanguli partem obtegebat; & uti clare visu agnoscebam, etiam ex lamellis, sive particulis lamellarum formam habentibus, concretus erat.

Quantum ad perexiguum istum Adamantem; illum quidem ex arte politum, sed fordidum seu vitiosum esse dixi: fordidus enim vocamus, dum vel subflavi sunt, vel rimis aut lineolis deformes: quamvis nonnullæ hujus Adamantis rimæ atque lineolæ nudis oculis conspici non possent; imo, adhibito etiam microscopio, visum pene effugerent.

Exiguus hic Adamas erat quadrangulus: prope unum istorum angulorum, intra ipsum Adamantem, varias vidi particulas ab invicem sejunctas; nisi quod aliquantulum sese attingere viderentur, quod initio insolens mihi visum est. Particularum istarum maxima coloris erat subflavi, & altero circiter latior quam crassior: nec splendore cedebat vitro. Reliquis particulis variæ erant figuræ; nonnullis etiam par splendor ac primæ: nec pauciores esse judicabam quam viginti: licet delineator tantum numerum non exprefferit.

Iste conspectus hanc mihi persuasionem induxit; quo tempore materia, Adamantum productrix, vagabatur in aëre; exiguas illas particulas, quæ itidem Adamantes erant, priori quem dixi Adamanti adjacuisse: materiam autem adamantinam, quamdiu talis materia aëri insedit, istam Adamantum congeriem paulatim circumvestiisse, & minores Adamantes inclusisse majori.

Qua occasione recordor complures me habuisse Crystallos montanas figuræ sexangulæ: in quarum nonnullis quasi inclusæ jacebant figuræ quædam perexiguæ & oblongæ, coloris subcœrulei; sed tam exiles ut, adhibito etiam optimæ notæ microscopio, vix agnosci possent.

Porro istius Adamantis, quem vitiosum appellavi, veram magnitudinem delineari curavi: quam expressam habes inter V & W. *Fig. 81.*

Deinde & perexiguos istos Adamantes, qui in majorem Adamantem inclusi exhibentur in icone 81 seorsum delineandos curavi; quos designatos vides per X Y Z A B C. Ubi per X Y Z denotatur exterius Adamantis *Fig. 82.* later, quod licet ex arte politum, ope tamen microscopii conspectum, colorem tam fuscum præferebat.



Per Z A B C D E isti denotantur exilissimi Adamantes ; quos in majusculo Adamante velut inclusos latuisse præmonui.

Cum postea latus Adamantis in icone 81 expressi, cui longe minores Adamantes inclusos fuisse mox dicebam, ad microscopium admovissem, Adamantem istum variis foraminibus pertusum esse comperi; quæ ego foramina tunc facta esse censui, quando latus illud poliebatur. Ita nimirum ut exiguiissimi, quos dixi, Adamantes loca illa prius infederint, sed poliendo delapsi foramina illa sive puteolos produxerint, quæ foramina conspicua sunt inter F G H.

Fig. 83.

Porro exiguum illum Adamantem, inter V W in icone 81 expressum, in latus suum verteram; & ubi crassiusculus erat, novaculum illi aptaveram, ut Adamantem ipsum ictu mallei diffinderem: quod tamen, licet iterato tentanti, non successit.

Quare Adamantem chartâ mundâ circumvolutum, imponebam malleo; & alio malleo, crebrius tamen feriendo, diffregi. Postquam omnes diffracti Adamantis glebularum diversis microscopiis applicaveram; unam, quæ plures quam reliquæ lamellas oculis exhibere videbatur, delineatori effingendam tradidi, quæ denotatur per I K L M. Haud tamen possibile delineatori fuit eâdem perfectione glebulam illam exprimere, quâ sese oculis conspiciendam offerebat.

Fig. 84.

Cum autem microscopium, cui frustulum illud iconis 84 applicatum erat, diversum esset ab iis microscopiis, quorum ope alia Adamantis frustra delineari curaveram; Delineator postremum hoc frustulum eâ magnitudine expressit, quam sine microscopio conspectum oculis offerebat: quæ vero frustuli illius magnitudo exhibetur inter N O.

Fig. 85.

Quædam ex his Adamantum fragmentis, ope microscopia considerata, jucundos præbebant conspectus: quos etiam nonnullis, talium rerum studiosis, exhibui. Illis autem jucundissimum erat, in uno Adamantis frustulo tam multiplices agnoscere partes: imprimis etiam quod lamellæ, ex quibus Adamantes concreti sunt, in duobus Adamantum frustulis valde distincte possent internosci; nempe dum lamellæ istæ juxta ductum longitudinis oculis objiciebantur.

Exinde studium meum converti ad examen CrySTALLI cujusdam montanæ, sex lateribus præditæ, cujus longitudo circiter respondebat latitudini duorum digitorum, crassitudo vero minori digito.

CrySTALLUM istam in complura frustra confregi, & frustra microscopiis applicavi; disquirere volens num & illa ex superstratis sibi lamellis composita essent: quâ ratione Adamantes magnitudinem suam adeptos esse dixi. Sed, tametsi perquisitionem istam sæpius iteraverim, ne tantillam quidem lamellam in iis deprehendi. Istud autem in CrySTALLIS, quas quidem præ manibus habebam, plerumque animadverti, in omnibus earum lateribus, quæ numero sena erant, transversas protendi lineolas, alias aliis situ aliquantulum superiores; tamquam si illic, incrementibus CrySTALLIS, ortæ productæque fuissent: quâ su-

per



per re. quantumcumque Cryftallorum numerum ante confideraverim, atque confregerim, numquam ipfe mihi fatisfacere potui.

XX. Having an Opportunity of difcourfing with a Gentleman recommended to me, that came from the Gold Mines in *Brazil* belonging to the King of *Portugal*, and brought many Diamonds of confiderable Value, lately found in thofe Places, I thought proper to defire of him an Account of the fame, being the fitteft Perfon to describe every minute Circumftance of it, as one that has lived, and digged Gold there for thefe fifteen Years laft paft; and he having obliged me with the faid Account, in the *Portugueze* Tongue I think it will not be unacceptable to the Society, to offer the Tranflation of it, which is as follows:

*Concerning  
Diamonds  
lately found  
in Brazil,  
by Jacob de  
Castro Sar-  
mento, M. D.  
and F. R. S.  
No. 421.  
pag. 199*

In the Prince's Town, Capital of the County *do Serro do Frio*, belonging to the Government of the Gold Mines, there is a Place near the faid Town called by the Natives *Cay the Merin*, where they ufed to dig Gold for many Years, as alfo from a fmall River called *do Milho Verde*. The Miners that digged Gold in thofe Places did turn up the Ground and Sands of the Banks of the faid River, to extract the Gold therefrom, and by fo doing found feveral Diamonds, which then they did not prize as fuch; for fome of the Miners kept feveral Stones for their Figure and Curiofity, which Stones (though fo valuable) by Length of Time they neglected and loft, and did the fame till the Year 1728, at which Time one of the Miners lately coming to work there, and better acquainted, deemed them to be Diamonds, made Experiments upon them, and finding them really fo, began to feek for them in the fame Ground and Sand, where the former Miners had ignorantly left them, fo did the reft of the People follow his Example.

After they had thoroughly examined the Places aforefaid, they began to fearch for them in the River itfelf, and do actually find Diamonds there, but with more Trouble and Difficulty; for in the former Places they found them together among the Earth and Sand, as they lay; but in the River, as the Sand is more difperfed, they lie farther from one another.

Experience and common Reason teaches the People there, that thefe Diamonds came from another Place by the Current of the Waters, and are not the natural Product of the Situation where they now are found.

They are uſing all poſſible Diligence to find out the Place where they grow. They have not yet diſcovered it; but their great Hopes are very much encouraged upon the Account of having near the faid Situation feveral Mountains, where nothing is to be ſeen but fine ſolid Cryſtal Rocks.

The Diamonds that have been found, are commonly from one Grain to fix Carrats, ſome larger, and among theſe one of forty-five Carrats. The Colour, Solidity, and reſt of their Properties are the ſame



same as the Oriental ones; only it was observed, that those Diamonds that lay more superficially, and exposed to the Air and Sun were more scurfy, and by Consequence lost more by polishing than the other.

*An Account of  
a Leaf of a  
Plant impress-  
ed in a piece of  
Amber, by Joh.  
Philip Brey-  
nius, M. D.  
F. R. S. N<sup>o</sup>.  
395. p. 154.*

XXI. Inter Corpora Naturalia Succinis à Natura inclusa, illa longe rarissima esse, quæ Vegetabili Regno suam debent originem, confitebitur mecum, opinor, quicumque Naturæ Curiosorum Pinacothecas, inque iis Succineas Gazas, non levem ipsis conciliantes splendorem, accuratius inspexerit, Authoresque de his rebus tractantes diligentius excusserit. Hæc inter autem cæteris Plantarum perfectiorum partes, ut folia, seminum receptacula, flores, si qui inveniuntur, &c. raritatis palmam præripiunt.

Hujus rei ratio proculdubio est, quod ex recentiorum mente, Succinorum officina naturalis, loca sint subterranea, quorsum partes Vegetabilium, utpote terræ superficiem inhabitantium, ægre & non nisi casu, eoque rarissimo pertingere possunt; cum Insecta, quamvis etiam in aëre viventia, tamen, ut se à frigore, aliisque aëris injuriis defendant vel alia etiam de causa, sponte sæpius rimas, hiatus & cryptas quærant & subeant subterraneas, & ad sepulchrum properent, ubi à Succino adhuc liquido irretiuntur, involvuntur, suffocantur, cumque eodem in ævum duratura rigescunt.

Ejusmodi glebam, quæ folium hujus notæ in sinu suo fovebat, nuper Mense Octobri præterito mihi exhibuit & examini subjecit meo hic *Gedani* Mercator quidam natione *Brittannus*, *Philippus Benlows*, qui eandem, inter alia Succina nactus, maximi, imo pluris quam triginta aureorum æstimabat.

Fig. 86.

Hæc ovalis ferme, sed compressæ erat figuræ & magnitudinis quæ in Icone exprimitur, quartam Unciæ partem crassitie æquans, illius generis, quod falernum, à similitudine vini, salutatur Succinum, & quidem satis perspicua & pura, neque vel levissima fraudis macula conspurcata. Includebat per totam ejus mediam longitudinem exprorectum Folium aliquod Botanicis pennatum, quibusdam etiam alatum quamvis minus recte, dictum; quod eleganti sane spectaculo, obscurum quidem, sed aureo colore coruscans, à reflectione & refractione radiorum luminis, oculis spectantium clare sese offerebat. Folium hoc non integrum, sed utraque extremitate mutilatum erat, ut ipsa indicat figura, quinque constans foliolorum oblongorum, utrinque non nihil acuminatorum paribus s. conjugationibus, quorum quædam erant ex parte exesa & mutila, in costa communi æque fere à se invicem distantibus. Situm erat in plano horizontali, quod in eo foliorum genere familiare est, præterquam, quod foliola obliquitate aliquantulum ab eo deflecterent; nequaquam vero conjugationes foliolorum decussatim positæ vel ullo modo videbantur, quod in foliis, quæ conjugata Botanicis dicuntur, semper obtinent; ut adeo folium hoc ex compositorum pennatorum genere esse, nullum mihi amplius restet dubium. Cujus autem exacte Plantæ speciei sit determinare



vix licet; quia multæ species hujus familiæ, foliis vestiuntur sibi adeo similibus, ut etiam si recentia, difficile sit à se invicem distinguere; accedit, quod nec venulæ foliolorum, vel oculis Microscopio armatis appareant, utpote quæ à Succino olim liquido oblitteratæ & quasi incrustatæ erant. Quam proxime autem accedit ad Securidacæ secundæ, *Clusii*, s. *Coronillæ herbacææ*, &c. *Tournefortii*, quæ in dumetis *Prussiæ* satis familiaris est. Ab altera parte, inter bina foliola, aranea satis clare conspicitur; ab altera vero parvula musca, sed hæc non nisi oculo lente armato.

Non memini me apud ullum Authorem folii hujusmodi in Succino pennati invenisse mentionem, præterquam apud *Michaëlem Mercatum* in nobili isto opere *Metallothecæ Vaticanæ* titulo inscripto, & immortalibus Archiatri Pontificii *Johannis Mariæ Lancisii* meritis à situ, oblivione & interitu liberato. Ubi, pag. 89. inter alias elegantium glebarum *Ranam*, *Pisciculum*, *Lacertulam* variaque Insecta continentium Icones, una etiam reperitur, quæ folium ejusmodi pennatum paulo minus, sed ob integritatem rarius & elegantius, octo conjugationum, foliolo extremo impari costam claudente, includit; quod parvum & tenellum *Coronillæ herbacææ*, flore vario, *Tournefortii*, folium egregie exprimit, quamvis etiam non male ad *Onobrychidem* secundam, *Clusii*, quæ pariter *Prussiæ* indigena est, referri posset.

Idem *Mercatus* aliam ibidem delineat glebam parvo in tenui segmenta dissecto folio, plantæ cujusdam, forte umbelliferæ, imprægnatam.

Interim tamen cum glebas memoratas, in laudato *Mercati* libro saltem, summo licet studio delineatas, non vero ipsas viderim, præterea figuræ *Ranæ majoris*, *Lacertulæ* & *Pisciculi*, non levem mihi artificiosæ fraudis excitent suspicionem, ego equidem pro genuitate earum vadium in me suscipere nollem; quia notum est affatim, Artifices, ejusmodi res adeo artificiose Succinis posse includere, iisque non nimium Curiosis imponere, ut non nisi ab expertissimis & oculatissimis possit detegi fucus.

XXII. *Sóowár* is an Hungarian Word (which signifies in German *An Account of Salt-Burg*) composed of *So*, which is to say Salt, and *Wa*, which signifieth Burg or Town. It is a large Village, about a Quarter of a Mile from *Eper*, a City of the County of *Saár* entirely peopled with Officers of the Excise, and Miners or Wood-cutters, and is situated on the Summit of a little Hill, with an agreeable Prospect.

The 16th of July 1724, we came from *Rosenaw* to *Sóowár* with Dr *Poëkin*, Physician to the City and County, to view this celebrated Salt-work, which furnishes the finest and most pure Salt of the whole Kingdom. We communicated our Intention to an Officer of the Salt-works, and having asked his Leave to go into the Cuts, he gave us two Guards for Guides. We first descended with them into the Well by a Rope, seated on *Leathern Dogs* (as they term it) about forty Fathom deep; after which we again descended one hundred

*An Account of the Imperial Salt-works of Sóowár in Upper Hungary, translated from the High-dutch of Ernest Bruckman, of the Academy of Brunswick, M. D. communicated by Sir Hans Sloane, Bar. Pres. R. S. No. 413. pag. 260.*



Fathom, by holding ourselves perpendicularly against the Wall and Sides of the Wells; and having again continued our Journey under Ground in the Salt-work, we then found ourselves in the Cuts, and saw all the Allies cut in the finest Rock-Salt; in the midst of which there were here and there some Veins of Flint of a dark Grey. The Miners work to cut this Rock-Salt, which they draw up by a Rope, and put it into a Reservoir, where they cleanse it with Salt-water. They boil it afterwards with the same Water, until it becomes of the Consistence of Crystal, and then put it into Vessels, which contain about 268 lb. each, and then send it into *Silesia* and other Countries.

In regard to the Vegetable or Fossil Salt, it is extremely white and transparent; it is in such Plenty in the Salt-works of the County of *Marmer* near *Transylvania*, where there are large Mountains entire of Salt, that one might furnish the whole World, in regard to the great Quantity; as also, because as soon as you cut it, it grows again a-new in a very short Time. They break and cut it, and although it appear at first black, nevertheless in pounding it becomes extremely white: And so it is with that which they use themselves in *Hungary* (for they send all the Salt of *Sóowár* into Foreign Countries). You find almost in every Inn, two Stones like to those used to make Mustard, between which they pound and break that Sort of Rock-Salt; and one finds also in their Stables, large Pieces of that Mineral, which the Cattle lick at Pleasure.

But to return to the Salt of *Sóowár*, one finds sometimes in the Cuts, Allies of Rock-Salt of the most delicate blue and yellow Colours: We observed, that of the first Colour being exposed to the Sun for some Days, lost entirely all that beautiful Ultra-Marine, and became white as the other Rock-Salt, which did not happen to the Yellow, which preserved it's Colour; but when you pound them both together, the Salt was neither Blue nor Yellow, but produced a Salt extremely white.

*Meliffantes* in his new Geography, Page 428, speaking of Salt-works which the *Spaniards* have in *Catalonia*, says, that there is Rock-Salt, the Colour of which is so diversified, that it comes near the Rainbow, in having green, red, yellow, and blue Colours, but that by first preparing, and then grinding it, it became white. The same Thing happened also to the red Rock Salt of *Salzburg*, which being pounded became white.

There is in this Mine one very remarkable Thing, that is, a Chapel, which is able easily to contain a hundred People cut in the Rock-Salt, with an Altar, a Pulpit, a Sacristy, Chairs, and Forms cut in the same Rock. They celebrate once every Year, the Week after the *Epiphany*, Divine Service in this Chapel. It is always a Jesuit of *Eper* who preaches the Sermon. This Service was founded for the Officers of the Excise, and the Miners.



There is in these Cuts, four Fountains of Salt Water, which they put into Buckets made of Buffalo's Skins sewed together, and draw it up by an Engine worked by Horses, and convey it by Pipes into the Boilers, where they put the Rock-Salt to dissolve, which they afterwards boil till it becomes like Crystal. By express Mandates of the Emperor, no one can sell that Fossil Salt, neither can the *Hungarians* employ it for their own Use, much less drive any Trade in it but they boil it all, and export it into foreign Countries.

They find here also a Sort of crystallized Salt, like to the Crust sticking to the Pipes of Wood: The Miners call it Salt of Crystal; it is very white and transparent, but this appeared to us, nothing else but Salt falling Drop by Drop in it's Passage in the Pipes, and so crystallizing, which they easily also separate.

But that which is most curious and remarkable in these subterraneous Fosses, are the Flowers of Salt which grow as the Beard of a Goat, with this Difference only, that these here are much whiter and much finer. One cannot enough admire these Vegetables, yet one cannot find them in all the Cuts nor at all Times, but they appear and grow according to the Temperature of the Seasons, which in those Parts is very wholesome, and without any thing noxious. These Sort of Plumes of Salt are very brittle, they melt also in moist Places, and dissolve into an evaporated Oil, but are nevertheless the most pure Salt, the finest, the most acid, the most white, and most beautiful; so that it is not without Reason they have given it the Name of Flower of Salt.

The Salt of *Sóowár* is esteemed the best of all *Hungary*, the greatest Part of which they export into *Silesia*, *Moravia*, and *Bohemia*, and the *Hungarians* dare not use any of it themselves, under Pain of Banishment. They make every Year about 50,000 Tun, every Tun containing 268 lb. but by an Ordinance of his Imperial Majesty, they will henceforward boil about 100,000 Tun, which they will export as the other. *Martin Zeiler*, in his Description of the Kingdom of *Hungary*, Pag. 119, makes but slight Mention of these rich Salt-works.

In fine, we saw at *Neusol*, at Mr *De Neffzern's*, Receiver of the Emperor's Rents, a Statue of Rock-Salt as large as Life, which serves as the Barometer of *Neusol*; for when it begins to sweat, or grow moist, it presages Rain, or wet Weather; but when it is dry, you may certainly promise yourself settled fair.

After having employed three Hours to view these Salt-works, we ascended again by the upper Opening, by a common Rope, and returned to *Eper*, where we were civilly entertained by Mr *Topprerer* one of the most knowing Men in all *Hungary*, Rector of the *Lutheran Academy*, who understands and speaks ten Languages in Perfection.



*A Discourse on  
the Cobaltum  
or Smalt, by  
Mr Joh. Hen-  
ry Linck, of  
Leipfic, F.R.S.  
No. 396. p.  
192.*

XXIII. Cobaltum est minera grisea, obscurè albicans, mineræ argenti albæ, & pyritæ albi, quoad colorem æmula, sed paulò obscurior, continens arsenicum album & terram fixam, cum filice & cineribus clavellatis in vitrum cœruleum abiens.

Effoditur in Schneebergensium & Annæbergensium terris, inprimis in Cervi, Rappolti, centum millia equitum, Galilææ, & quotquot sunt, puteis; & quidem in venis propriis, idque ita purum putumque cum durissimo filice, seu, quod vocant quarzo, ut, si quæ fortè alia minerarum genera interspersa seu adfixa alicubi reperiantur, non simul cum vera Cobalti substantia, filici dicto innata, sed aliis ex causis, imo aliis venis associata non obscurè appareant.

Signorum externorum ejus proximum & indubium est minera quædam rosei coloris, structuræ radiatæ, quam Cobalti florem, *Cobald-Blütthe* vocant; inter egregia & spectatu digna in minerarum gazo-phylaceis recondita. Hujus operis datur & alia, coloris verò non adeo rosei nitidi, sed pallidioris, nulliusque structuræ, sed pulveris instar mineram ambientis.

Signum propius præbet accurata ocularis collatio mineræ hujus cum pyrita albo; accuratior cum minera cupri grisea; accuratissima cum minera argenti alba; cum quibus rebus interest ipsi non levis coloris similitudo, essentiæ maxima differentia; quod verò verbis nec exprimi, nec concipi satis potest, ita, ut frequenti opus sit intuitu.

Signum proximum, seu res ipsa manifestatur ex vitro inde confecto quod ex pyrita nigrum, ex dicta cupri minera rufum, ex argenti alba & cupri partecipe minera, jam magis minusque nigricans; ex Cobalto vero sapphirinum prodit, unde & Zaffera, tum pro Cobalto tosto, tum etiam pro vitro cœruleo in pulverem redacto, nomen ortum, verosimile est.

I. Per se Cobaltum auræ, pluvix, soli in cumulo diu expositum efflorescit rosei vel persici coloris qui dicitur, flos Cadmiæ, sed cum illo flore nitidiori antea descripto, non confundendus. Ille ritè extractus; reddit substantiam elegantissime rubram, & ad hæc vitrioli obscurè viridis portiunculam, quæ merentur ulteriorem investigationem; mineræ autem non parvam quantitatem, tempus & assiduitatem & patientiam requirunt, cujus rei encheireses noster laudatus D. Henkel compertas probe habet.

II. Spiritus Nitri solvit illud cum impetu & effervescentia, v. g. vi. vel iv. partes ad unam, quatenus minera pura vel minus est; unde verò resultare solet solutio non unius coloris. Viridis nempe color Vitrioli Veneris prope est, si cuprum certè continet; quod apparet in illa Cobalti minera, quæ *Kupfer-Nikel* appellatur, & adhuc cruda cupreum colorem præ se fert. Viridis tamen etiam provenit aliquando ex ea minera quæ tota grisea, & nullatenus ad visum cuprea, quamvis ad colorem solutionis Vitrioli Martis puri accedens; tamen à cupri contactu non planè aliena. Obscurè flavescientem solutionem reperio



reperio optimam ad vitrum illud sistendum cœruleum. Rubicunda implicatam sibi significat mineram Bismuthi.

III. Solutiones, cum Alkali, v. g. oleo tartari per deliquium præcipitatæ reddunt pulverem porcellanæ debite applicatum, egregiè cœruleum, si contigit, cætera paria, inprimis Cobaltum selectissimum, atque ignis te esse expertum Directorem.

IV. Acidum Vitrioli & Salis communis adoriuntur quidem Cadmiam nostram, sed non tam solvunt, quam erodunt, inprimis Vitrioli acidum, & in pulverem album reducunt, adeò ut spiritus Nitri convenientior sit solvendæ Cadmiæ,

V. In vase clauso, retorta lapidea loricata, vel sublimatorio alio, igne aperto debite detentum effumare patitur partem volatilem arsenicalem, ab initio aliquantulum fuliginosam imo & sandaraceam, atque ita sulphuris communis non planè expertem, quam maximè autem se colligentem in forma semimetallica splendida, regulina, foliata, qualis ex pyrite albo provenit, ubi verò splendor per dies, imo per horas evanescit, luculento indicio, particulas aërias in substantiam illam habere ingressum.

VI. In furno vero tostorio (*Rost-olfen*) ubi flammæ igneæ minerum contingunt, adhærescit camino vel ductibus adstructis sicuti pulvis (*Mehl*) cinereo-albicantis coloris, qui colligitur pro conficiendo illo arsenico albocrySTALLINO.

VII. Remanet terra fixa, cinerea, vitrescibilis.

VIII. Minera Bismuthi (de qua quidem hoc loco specialissimus sermo non est, tamen cœruleo maxime inserviens, non prætereunda) igne aperto facilè effluere finit substantiam semimetallicam, quæ Bismuthum appellatur, & ad alios usus venditur; & relinquit lapidem seu terram itidem griseam, fixam, dictam *Bismuth-graupen*.

IX. Minera illa quantum possibile, si pura, segregatur ex Cobalto strictè sic dicto, ut Bismuthum colligatur. Sed interdum, imo non raro illud ita inspersum & intertexum est; ut separari ab hac minus planè queat; hinc in ollis vitrificatoriis subsidet substantia regulina, dicta *Speisse*, coloris communiter albo-subrubicundi; quæ tamen rarò vel nunquam Bismuthum ita purum est, sicuti hoc ex sua minera per se emanat, sed commixtam sibi habet peregrinam inter alia terram fixam cobalticam. Atque ita novis compositionibus vitrificatoriis iterum commiscetur. Subdividunt aliqui regulum hunc in Marcasitam *Gloken-speisse*, & æs caldarium, quorum illa inferius, hoc superius hæret.

X. Terra utrinque remanens fixa, per se difficillimè vel planè non in vitrum abit, quamvis in furno vere vitrificatorio per 8 horas illam detinuerim, vix quod unam vel alteram maculam subcœruleam crucibulo Hassiaco adnotaverit. Et quoniam fabuli granula argillæ vasorum istorum inhærentia concurrunt dubium adhuc manet, utrum per se talis sit, quæ sine addito cœruleum possit constituere vitrum; quin  
hoc



hoc negandum mihi inde videtur, quia massa, ubi vas non tangit, non nisi grisea est & manet.

XI. Terra ista non planè sterilis, sed metalli particeps est. Quod cuprum hoc sit, facilè præsumitur, si non è colore solutionem, tamen ex vitro cœruleo planè inde confecto, & ex agnatur Cobalti minera, *Kupfernikel*. Quod verò paucissima metalli qualitas hic sit, non solum ex levitate terræ, sed etiam exinde apparet; quia neque ex Cadmia optima neque ex agnata, utut à Venere denominata, substantia metallica cuprea ullatenus elici & colligi potest. Quicquid autem de cupri portinnucula prætendi queat, illa tamen per se, quæ sit definienda non est, nisi quod dicamus, eam Cadmiæ peculiarem esse atque specificam.

XII. Datur Cobaltum, quod etiam intostum, vitrum cœruleum porrigit, imo quandoque elegantius, quam ubi tostum fuit; quod non ex aspectu mineræ, sed per experimentum discendum est.

XIII. Itidemque per experientiam elucescit cognitio circa ignis gradus & continuationem, siquidem alia minera longiore & brevior, fortior & levior opus habet tostione.

XIV. Adjuvatur & vitrificatio & coloris elegantia per additum pulverem arsenicalem, imo arsenicum crystallinum ipsum.

XV. Regulæ quidem non planè non universales prostant, ad quas Cobalti tractatio pro cœruleo vitro instituenda est; sed non constantes, quod jam significavi. Opus igitur est non solum in privato laboratorio variis, iisque tam secundum proportionem, quam ignis modos & gradus, & reliqua, experimentis; sed & in officinis Cobalti ipsis, ut docimasta indefesse experiendo invigilet naturæ mineræ & affixarum, atque ita compositionibus & laboribus, utpote in re colorum quasi delicatissimis, rectè prospiciat, iisque ad votum minus succedentibus vel addere, vel absumere, vel corrigere aliter sciat.

XVI. Cobaltum igitur in hunc finem experturus, probe oculis consideret illud, utrum & quam purum à lapide & adhærentibus, vel hoc minus aut quam minus sit; torre vel calcina, donec fumi cessent; commisce pulveri remanenti silicis vel sabuli silicei purissimi, albisimi, 1, 2, vel 3 partes, cinerum clavellatorum vel partem, vel pro fluxilitatis mineræ gradu plures, misce probe,ingere in crucibulum, si datur, subtus conicum, quali utuntur cuprum experientes, *Kupfer-Tiegel*. Si bene fluxerit, quod baculo ferreo experieris, quodque ocus seriusque sit, quatenus furnus & ignis sunt, exime crucibulum, & frigefactum vitrum scoriis separa; separatum pulverisa, non in vase ferreo, utpote colorem obscurante, sed, si prostat, in porphyrio, vel alio durissimo lapide; pulverem lava ab eo, quod albicantis sive grisei coloris est, *Eschel* seu *Schlamm* vocatum, atque tum hoc, tum illud desicca; desiccatum utrumque trajice per cribrum angustissimum; quod crassum, iterum tere cum aqua, desicca, donec omne comminutum sit. Tandem confer cœruleum obtentum tuum cum



cum exemplaribus colorum, (*Musters*;) quæ gradus, ordinem, titulos atque pretium suum publica lege jam constituta habent, & videbis, quid Cobaltum sumptum importet, & ubi error aliquis factus sit.

XVII. In grosso, ut aiunt, procedendi hic modus est. Cobalti minera è puteo tracta, ab heterogeneis omnibus malleo, quantum potest, separata, calcinatur in furno, qui fornicatus, latus, plani ferè fundi est, atque ignem flammeum ab alio prope adstructo furno anemio super mineram recipit. Huic ex opposito furni anemii introitus apertus est, ubi quidam rutro Cobalti terram circumvolvit, quo ignis undequaque in eam agat, atque arsenicum eò melius disjiciat, donec non amplius fumet. Adhæc calcinantur filices electi purissimi, & jam candentes projiciuntur in aquam frigidam, ut magis tractabiles fiant; ita præparati tunduntur in pulverem seu sabulum. Tum Cobalti tosti pars una cum filicum partibus ut plurimum tribus, & ut eo facilius fluat, cinerum clavellatorum parte una, in cista quadam commixta funditur in furno vitrificatorio, in magnis ollis, igne per 8, 10, imo 12 horas intensissimo; atque operarius (*der Schurknecht*) unco ferreo magma jam fluens strenuè circumagit, ut omne in æqualem fluxionem abeat. Ubi tandem, quam potest limpidissimè fluit, cochleari magno ferreo vitrum exhauritur, & in alvearium, aquâ repletum, projicitur. Vitrum ita magis friabile redditum tunditur malleo, quem aqua agit (*gepucht*;) tufum trajicitur per cribrum orichalceum. Remanens ulterius tunditur, & trajectum in mola cum aqua subtilissimè pulverisatur. Hoc lavatur tum ad abstersionem particularum salinarum, aliarumque sordium, tum ad separationem pulveris illius cinerei albicantis levioris, quem *Eschel* appellant à cœruleo, quod *Blaue Farbe* dicitur, secundum rationem, quod alias *Schlemmen* dicunt. Tandem in vasa per centenaria conditur, & per totum terrarum orbem divenditur. Sicut verò hujus rei, atque hinc pretii maxima differentia est, ita vasa certis litteris notantur, ita ut O. C. significet *Ordinair Cobolt*. M. C. *Mittel Cobolt*. F. C. *Fein Cobolt*. F. F. C. *Fein, Fein Cobolt*. F. F. F. C. *Fein, Fein, Fein Cobolt*; id quod vero ut pretiosissimum, ita & rarissimum est. Minera Cobalti ita præparata, aliàs *Schmaltum*, *Smalte*, & mulieribus, *blaue Starcke*, quo utuntur pro linteis dealbandis, communitur, appellatur.

XVIII. Venditur & Cobaltum tantum tostum, & cum duabus vel tribus partibus filicum vel quarzi commixtum, sub titulo *Zaffor*, item *Zaffera*, pro figulis. Ubi hoc meretur commemorari, quod pulvis hicce in vasis, quibus devehitur, tam compactum fiat, & quasi concreseat, ut duri lapidis instar, malleo opus habeat ad comminendum.

XIX. Cæterùm Cobaltum per se argentum non continet. Quamvis enim detur ejusmodi vena, ex qua nobile hoc metallum excoquatur, tamen non nisi per accidens fieri exinde liquet, quia eadem vena illic plus, hic minus, & ut plurimum planè non argentifera est.

XX. Hoc



XX. Hoc non obstante, argentum nativum super Cobaltum non rarò reperitur, quod verò non aliud, quam hoc arguit, mineram illam argenti non incongruam esse matricem.

*The Method of making Tin-Plates, extracted from the Memoirs of the Academy of Sciences, for the Year 1725, by William Rutt, M. D. R. S. Secr. No. 406. p. 630.*

XXIV. The making of Tin-plates or Latten, as it is called, being not commonly practised in *England*, though there is so great a Consumption of it, either because the Method is not sufficiently known, or because that in Use to make small Quantities for particular Purposes is much too dear to answer the Artificer's Expectation in making larger, whereby we are obliged to export our own Tin to *Germany*, to receive it back again *manufactured*; I thought it not improper to lay before the Society the Method the *Germans* themselves make use of, as I have extracted it from a Dissertation of Mr *De Reaumur*, printed in the last Volume of the Memoirs of the Academy of Sciences of *Paris*, in which also he lays down some Improvements, as he thinks, of his own.

He takes notice then that the making of Tin-plates, (which is called in *France*, *white Iron*) does not properly begin, till they go about to prepare the Leaves or Plates of Iron that are to be tinned, which are supposed to be sufficiently thin and flat, and cut into Squares; But there are only certain Sorts of Iron which can be reduced into these Leaves, of which those are the most proper, that when heated are easiest extendible, and yet can be forged with a Hammer when cold; the more soft and extremely flexible, as well as the more brittle being to be rejected. These Leaves are drawn from Bars of Iron, about an Inch square; which being made a little flat, they cut into thin Pieces or Soles (*semelles*) which they fold together, and having made them into Parcels containing forty Leaves each, beat them all at once with a Hammer that weights from 600 to 700 lb. After this, the principal Part of the whole Art is to prepare these Leaves; for the lightest Dust, or the least Rust upon their Surface will prevent the Tin from uniting with them. This may indeed be taken off by filing, but that being much too expensive, the same may be brought about by steeping the Plates in acid Waters, for a certain Time, to what Number they please, and when they are taken out, scouring them with Sand, in order to fetch off any Thing that may remain upon the Surface: And by this Method a Woman may clean more Plates in an Hour, than the most expeditious Workman can file in many Days. Of these Waters the Author mentions several; but what the *Germans* themselves used, and which they make a mighty Secret of, he found to be only common Water made eager with Rye, which requires very little Pains. For after they have ground the Grain grossly, and pounded it, they leave it to ferment in common Water for a certain Time, and with a little Patience they are sure to have an eager Menstruum. With this Menstruum they fill Troughs or Tuns, into which they put Piles of Iron Plates; and to make it grow eager the better, and to have more



more Activity, they keep these Vessels in Vaults or Stoves which have little Air, and in which they keep lighted Charcoal. The Workmen go into these Vaults once or twice in a Day, either to turn the Plates that they may be equally exposed to the Action of the acid Liquor, or to take out those that are sufficiently cleansed, or to put others in their room: And as the Liquor is more acid, or the Heat of the Vault or Stove is more intense, the Plates are sooner cleansed; but it requires at least two Days, and sometimes a great deal more. This is the Method which the *Germans* employed in the Tin-works in *France*, constantly made use of to prepare the Iron-Plates to receive the Coat of Tin: But as the Author observed, that the constant Attendance upon them in the Stoves was very laborious, the Heat therein being almost insupportable to those who are not used to it, he proposes some other Methods which are attended with very little Trouble, and as small, if not a less, Expence; and which upon Trial succeeded full as well. Having therefore observed that the Iron-Leaves or Plates are covered with a Scale or Layer, half vitrified by the Fire, on which Acids have none or very little Effect, he imagined that instead of *dissolving* the Iron in these acid Waters, it would be better to make it *rust*, and thereby put it in a Condition to be easier cleansed from these Scales; as Rust is accompanied with a sort of Fermentation and Rarefaction, and the Matter which rusts takes up a greater Space, and raises up whatever opposes it. To this Purpose he steeped Iron Plates in different eager Menstruums, as in Water in which Alum, common Salt and Sal-ammoniac were separately dissolved; and others of the same Iron he only dipped into the same Waters, and instantly taking them out exposed them to the Air. These latter were rusted by all of them, but sooner by that in which the Sal-ammoniac was dissolved. After two Days, during which every Plate had been dipped into the Menstruum but twice or thrice, he scoured them, and likewise those he had left to steep for that Time; and comparing them together, found that those, which had been only wetted at different Times, cleansed better than those which were steeped; the Rust covering all the Surface of the latter without raising the Scale; whereas in the former, as soon as one Part of the Metal is detached, it is attracted by the Menstruum, and the Surface is raised into Blisters of Rust. These Dissolvents, the Author takes notice, tho' weak in themselves, yet produce the Effect as well as the stronger, which are much dearer: But amongst the latter he prefers Vinegar, which being very plentiful in *France*, may be used with little Cost. For you need only dip each Leaf into it, and take it out again immediately, leaving it afterwards in some moist Place, and it will be scaled in eight and forty Hours, if you take care to repeat this 3 or 4 Times in a Day. The scaling will still be more expeditious, if you dissolve a little Sal-ammoniac in the Vinegar, a Pound or two to a Puncheon; for as the Vinegar dissolves Iron well,



so Sal-ammoniac, as just observed, rusts it sooner than any other Salt: But this must be used very moderately, and the Leaf must be left to steep in clean Water to dissolve any Particles of it that may stick to it's Surface, which may otherwise make it rust after it is tinned. If you scale with Vinegar, and want to do it at a less Expence, you need only plunge the Leaves once or twice at farthest, and when the Vinegar is dried upon the Surface, sprinkle it with Water; or dip them into it, and take them out immediately. There are several other Ways of making Iron rust, as keeping it in a moist Cellar, exposing it to the Dew, sprinkling it with simple Water, several Times in a Day, which will still act quicker by dissolving Sal-ammoniac in it. In those Countries where the Pyrites is common, the Vitriolic Waters will scale them soon enough, which are almost as cheap as common Water: You need only heap the Pyrites together, and leaving them to moulder in the Air, make afterwards a Lixivium with them and common Water, which Lie will have the desired Effect: But as the Leaves of Iron are sensibly much easier cleansed on one Side than the other, the bad Side rarely taking the brilliant Polish in the tinning, but having always some Spots, which proceeds in that in the beating one Side is more exposed to the Action of the Hammer, and is therefore better plained, the Author again advises not to steep them, but only to moisten them, in order to make them rust, whereby you need moisten that Side only that wants it most: Whereas if you steep them, as the bad Side will take double or tripple the Time of the other, the acid Menstruum will dissolve the Surface, and occasion a Loss of Iron. He next gives two Cautions necessary to be followed: the first is in the Management of the Plates before they come to be prepared; which is in the beating of them, to change the Place of each in it's Turn, that every one may receive the immediate Action of the Hammer, otherwise they will not extend equally: the second is to steep them in Clay or Fuller's-Earth tempered with Water before you heat them, to prevent their soldering with one another. He then closes this Part of the Operation with remarking that whatsoever of these Methods are pitched upon, whether the old one, of which he has learnt the Secret, or any of the new, which he has here shewn, it is absolutely necessary after the Plates are sufficiently scaled, to scour them with Sand, and when there remains no more black Spots upon their Surface, to throw them into Water to prevent their rusting again, and leave them in it till the Instant you would tin them, or in the Term of Art, blanch them. This he observes is the very Object of the whole Art, and is kept as much a Secret by the *Blancher*, as the acid eroding Menstruum is by the *Scaler*: But the Manner of doing it is thus. They flux the Tin in a large iron Crucible, which has the Figure of a broken Pyramid with four Faces, of which the two opposite ones are less than the two others. This Crucible they heat  
only



only from below, it's upper Border being luted in the Furnace quite round. The Crucible is always deeper than the Plates which are to be tinned are long, which they always put in downright, and the Tin ought to swim over them. For this Purpose Artificers of different Trades prepare the Plates in different Manners, which are all exceptionable: But the *Germans* he perceived made use of no Preparation whatsoever, except putting the scoured Plates into clean Water, as just remarked; but when the Tin is melted in the Crucible, they cover it with a Layer of a Sort of Suet, an Inch or two thick, through which the Plate must pass before it comes to the Tin: The first Use of which is to keep the Tin from burning, and if any Part should take Fire, as the Suet will soon moisten it, to reduce it to it's natural State again. This Suet is compounded, as the Blanchers say, and is of a black Colour, which the Author thought might be given it with Soot or the Smoak of a Chimney, only to spread a Mystery over their Work; but he found it true so far, that common unprepared Suet was not sufficient: For after several Attempts, there was always something wanting to render the Success of the Operation certain. The whole Secret then of Blanching lies entirely in the Preparation of this Suet; And this he at last discovered to consist only in first frying and burning it; which not only gives it the Colour, but puts it into a Condition to give the Iron a Disposition to be tinned, which it does surprizingly. The Tin itself ought to have a certain Degree of Heat; for if it is not hot enough it will not stick to the Iron; if it is too hot, it will cover it with too thin a Coat, and the Plates will have several Colours, as a Mixture of red, blue, and yellow, and the whole appear of a villainous yellow Cast. To prevent this, by knowing when the Tin has a proper Degree of Heat, they might first make an Essay with small Pieces of the scaled Plates, and they would learn from them when the Tin is in proper Order: But generally speaking, they dip the Plates into Tin that is more or less hot, according to the Thickness they would have the Coat to be of. Some Plates they only give one Layer to, and these they plunge into Tin, that has a lesser Degree of Heat than that into which they plunge those Plates which they would have take two Layers; as also when they give these the second Layer, they put them into Tin that has not so great a Degree of Heat, as that into which they were put the first Time: Besides which, it is to be observed, that the Tin, which is to give the second Coat, ought to be fresh covered with Suet, but only with the common Sort without Preparation; for melted Tin is sufficiently disposed to attach it self to solid Tin; and in this Case it is to Tin itself, to which the new Tin is to be joined. As to the Choice of the Tin, the Manner of making it is as bright as possible, with a Number of little Articles necessary to the Practice, the Author refers them to another Time,



as more properly belonging to the Description of the whole Art, than to a Memoir in which he only gives the Principles of it.

Chatham-Dock, Octob. 9. 1723.

*Right Honourable,*

*A Letter from the King's Officers at Sherneſs and Chatham, to the Hon. the Commiſſioners of the Navy, giving an Account of what they met with in opening an antient Well near Queenborough in Kent, communicated by Mr Peter Colliſon, F. R. S. on January 8, 1729. No. 411. p. 191.*

XXV. **I**N Obedience to your Honours Warrant of the 16th of September laſt, we met at the Well near *Queenborough*, where the Caſtle formerly ſtood, on *Tueſday* the 24th *ditto*, and finding but very little Water at the Bottom on our Sounding, and it having a new Curb, lately fixed on the Top, we provided our ſelves with Buckets and Ropes, and lowered down a Man, who acquainted us, that it was cleaned, and the Ground ſunk four Feet deeper than the Curb at the Bottom. We then meaſured the Depth of it, and found it 200 Foot, and artificially ſteened the whole Depth with circular *Portland Stone*, which is all entire, and ſtands fair, the mean Diameter is four Foot eight Inches; but obſerving, that not one Drop of Water came into it, we reſolved to try whether we could find any by Boring; in order thereunto, we applied ourſelves to make the neceſſary Preparations, by getting a Piece of Timber of about ſeven Foot long, and boring it through with a three Inch and a half Auger, which Trunk we fixed at the Bottom of the Well, and faſtened it by Quarters to the Curb at the Bottom, to prevent it's raiſing, and filled it all round three Foot deep with Clay, and on that laid four Courſe of Bricks for a Platform for the Men to ſtand on in their boring, and got alſo an Auger of two Inches and a half to bore through the Clay, but could not get all the neceſſary Appurtenances till *Thurſday* the 26th of *September*, when three Men at a Time began to bore, whom we ſhifted every three Hours; the Boring which they ſent us up, was a very cloſe bluish Clay, which continuing the ſame after three Days and a half boring, we began to deſpair meeting with Water; but on *Monday* the 30th of *September*, in the Evening, as they were boring, the Auger ſlipt down at once, and up came Water, to our great Satisfaction; and in an Hour's Time there was upward of four Foot Water which roſe ſo faſt, that at twelve o'Clock at Noon,

	Feet.	Inch.
On the firſt of <i>October</i> , we found - -	55	10
On the 2d, at 5 in the Afternoon, - -	109	08
On the 3d, at 3 in the Afternoon, - -	132	06
On the 4th, at 3 in the Afternoon, - -	149	06
On the 5th, at 4 in the Afternoon, - -	161	03
On the 6th, at 10½ in the Morning, -	167	08
On the 7th, at 4 in the Afternoon, - -	174	00
On the 8th, at 7 in the Morning, - - -	176	07

and ſtill increaſes, though ſlowly. The Reaſon of it's not riſing ſo much now as at firſt, we apprehended proceeded from the Weight of Water



Water which the Spring through the Hole of the Trunk must force up, and the Well being wider aloft than below. What we think very extraordinary is, that we bored 81 Feet below the Foot of the Trunk before we met with this Body of Water, which by Computation is 166 Feet below the deepest Place in the adjacent Seas. The Water proves excellent good, soft, sweet and fine; we compared it with the best Spring Water brought from *Milton*, and in every Body's Opinion that tasted both, they declared the Well-Water the best. We put some Soap to it, and it lathered finely; we boil'd old Pease in it, which performed very well, and we have great Reason to believe, that the Spring will sufficiently supply his Majesty's Ships, as propos'd.

Signed by

*Richard Frost, James Young, Edmond Oxley, Benj. Roswell, Richard Stacey, J. Hayward, John Ward, William Hogg, J. Dod, Charles Finch, D. Devert, William Jones,*

King's Officers at *Shernefs* and *Chatham*,

XXVI. This Treatise contains an accurate historical Account of the several violent Earthquakes, which happened in the Kingdom of *Sicily*, in the Years 1693, 1694, and 1717. interspersed with some Philosophical Digressions concerning the Causes and Effects of Earthquakes in general.

The Summer Season, in 1692. was exceedingly hot and tempestuous, with frequent Thunders, Lightnings and Rains. About the middle of *September* fell such profuse Showers, that all the Rivers and Torrents increased to such a Degree, as to overflow their Banks in several Places, and cover large Pieces of Ground with Water. This joined to the continual blowing of Southerly Winds, during the *Autumn*, put the Inhabitants under great Apprehension of future Mischiefs. And indeed, the disastrous Fate, which befel *Sicily* about the Beginning of 1693, too manifestly proved, that this ominous Fear was no way groundless. For on the 9th of *January*, about the 5th Hour (according to the *Italian* Way of counting) after a warm, serene and calm Day, the Earth began trembling all of a sudden, chiefly about *Catania*, and in some neighbouring Places, for the Time required to say the Lord's Prayer. This first Shake was accompanied, as generally happens in Earthquakes, by a hollow, thundering Noise, and succeeded by another small Trembling, observed only by some few People the next Day early in the Morning. These two Succussions, though violent enough, were but a Prelude of the third, which happened the 11th of the same Month, by 4 of the Clock in the Afternoon, of which the Apprehension was so much the greater, because all the 10th and 11th, between the first and third Shake, the Air was more than usual dark and cloudy. It would be a Task too difficult even for the ablest Pen, to describe all the dreadful Effects of this last; the violent tossing and dancing of the Earth; the hol-

*An Account of a Book entituled, Dominici Bottoni, de immani Trinacriae Terrae Motu Idea Historico-Physica, in qua non solum Telluris concussiones transactae recensentur, sed novissimae Anni 1717. Messanae 1718. 8o. By J. G. Scheuchzer, M. D. R. S. S. No. 384. P. 151.*



low, thundering Noise threatening the whole Island with it's entire Dissolution; the fiery Eruption of the burning *Ætna* throwing out a prodigious Quantity of Flames, Stones and Ashes; the Terror and Confusion of the distracted Inhabitants running up and down the Streets, uncertain where to provide for their Safety, or how to escape the Fury of all the raging Elements, which seemed to have conspired their Ruin. There was scarce one Place all over the Kingdom left without some particular Misfortune, *Catania*, *Syracusa*, *Agosta*, *Messina*, *Noto*, *Ragusa*, *Leontini*, *Ibla*, *Chiarumonte*, *Carleontino*, *Caltagirone*, *Soctino*, *Francofonte*, *Bontello*, *Militello*, *Occhiali*, *Aydono*, *Motica*, *Mascali*, were all, if not entirely destroyed, at least miserably shattered, many Churches and stately Buildings, up and down the Country, violently thrown down, and above 60000 Inhabitants buried under the Ruins, of which about 16000 perished only at *Catania*.

In many Places the Earth gap'd prodigiously. Such an Opening was observed near *Messina*, in the very Bottom of the Sea; another near a Village called *Botto d' Aceto*, 250 Paces long, and near 8 Palms broad; another at *Caltanissetta*, near the Jesuits-Collge, 2000 Paces long and 2 Palms broad; another, at the Top of a Hill near *Leontini*, full wide enough to hold a Man; another upon the Road between *Catania* and *Leontini*, which swallowed up some Mule-keepers, then, to their great Misfortune, happening to travel that way, along with their Mules and whole Baggage, that not the least Footstep of them remained. Silently to pass over a great many more, but of less Consideration.

Out of all these Openings sprung forth a great Quantity of Water, which drown'd the neighbouring Places. This Water was in some Places hot, with a strong sulphureous Smell, which lasted, even after the Earthquakes were over, and induced some of the Inhabitants, not without Success, to make use of it in curing of Ulcers, and other cutaneous Diseases, for which chiefly a hot Well near *Lazaretto* became very famous. Out of some of these Gapings of the Earth issued a thick Stench and Smoke, very troublesome to all the Neighbourhood. This happened, amongst other Places, upon a Mountain called *S. Theodor*, as also near *Mena*. Near *Agosta* it was preceeded by a sulphureous red Flame.

Just at the Time of the second Shock, the Sea retired from the Land all along the Coasts, leaving it's Bottom dry'd up for a considerable Distance, and within few Minutes returned again with great Fury, and overflowed the Shores. By this Accident the *Maltese* Gallies, lying at Anchor in the Harbour of *Agosta*, were in danger of being lost; for the Sea sunk down all of a sudden, so that they came to sit almost upon the Ground, and immediately after bubbled and swelled up again with so great an Emotion, that they run the Hazard of having their Cables broke, and being driven away.

And



And it seemed that the Earth itself was in some Places considerably lower'd, and the Tops of the Mountains depressed. Of this they had a remarkable Instance at *Paternione*. The Hills, between this City and the Shore, hindered it from having any View of the Sea, which since the Earthquake discovers itself towards the East very plainly.

In other Places the Earth actually sunk down, and instead of it appeared great Lakes, some of which were large enough to become navigable. By the breaking forth of such a Lake between *Noto* and *Syracusa*, a large Piece of Ground was transported for about 50 Paces, where it now stands as firm, as if it had always stood there.

The Loosening and Fall of two great Rocks between *Terula* and *Cassero* is already sufficiently described in Signor *Bonajuti's*\* Account: Such Loosenings and throwing down of great Rocks happened every where up and down in the Country, to the great Terror of the neighbouring People. The same was also observed, according to *Kircher* and several other Authors, in some Earthquakes in the Kingdom of *Naples*. Two very high Rocks near *Ibla*, with all the Trees growing thereon, were by the Violence of the Fall quite inverted, that the Top came to stand upon the Ground.

About two Miles off from the City of *Mena*, lies a Lake full of a bituminous, sulphureous and combustible Matter, formerly famous under the Title of *Lacus Palicorum*. Upon this Lake there was observed, the very Day of the Earthquake, about a Quarter of an Hour before the second Shock, a great red Flame, like a fiery Column of above three Yards perpendicular Height, which, during the Earthquake itself, on a sudden disappeared.

At *Agosta*, the Misfortune was so much the greater, because besides all the dreadful Effects of the Earthquake itself, the Powder-Magazine, in the Castle, by some ill Accident, and perhaps by the violent Fall over one another of the Stones of some ruined Buildings (or by the breaking out of some subterraneous Flame) unluckily took Fire, by which the whole Castle was blown up with such a Fury, that some of the Stones were carried as far as the Islands *Thapsus*, which is near 8 *Italian* Miles distant from *Agosta*. By this Accident perished 1840 Inhabitants.

There remains still one thing worth observing, and that is the very Rise and Progress of this terrible Succussion. It arose in the South and proceeded from thence towards the North. For it was first observed in the Island of *Malta*; then in the Southern Parts of *Sicily*; and last, always with some Difference as to the Time, in the Northern Parts of the same Kingdom. But the Shakes were less violent the more it approached to the North. For the rest, it extended it-

\* *Phil. Trans.* N<sup>o</sup>. 207. pag. 2.



self so far, that not only the Island of *Malta*, but also *Calabria*, and some Parts in the Kingdom of *Naples* participated of it's Fury.

Nor was this the End of all the Miseries which befel this noble Kingdom: for the Earth continued trembling for several Months after, during the whole Year of 1693. In the remaining Part of *January*, and from that Time to the Beginning of the Summer, the Shakes came strong and thick, with hollow terrible Noises, and frequent Eruptions of *Ætna*. The most considerable were observ'd *February* the 15th in the Morning; *March* the 1st; *March* the 18th, by one of the Clock; *May* the 10th; *May* the 26th in the Morning. Towards the End of the Summer, the Shakes were observed to lose a great deal of their Force, and *Ætna* to throw out Flames and Ashes in less Quantity, when on the fourth of *September*, this ignivomous Mountain, having been some Days before very quiet, trembled and cracked all of a sudden, with so loud and thundering a Noise, as if some Thousands of Guns were fired all at once. This was succeeded by a new Opening, about 1000 Paces distant from the old Mouth, out of which immediately issued a thick Stench and Smoke, followed by a great Flame. The same Mountain opened itself in two other Places, with the like Noise, and Eruption of Smoke and Fire, the 25th of *September*, 1693, and the first of *April*, 1694. Since that Time the Shakes became visibly weaker and weaker, and at last entirely wasted.

As to the Earthquake which happened *April* the 22d, 1717. early in the Morning, and of which the Author hath given a short Account by way of Appendix; I shall not insist upon it's Effect, being much the same with the former, though far inferior as to the Degree of Violence.

Thus far, what I could gather out of this Treatise, relating to the History of the *Sicilian* Earthquakes in 1693 and 1717. I proceed now, with all possible Brevity, to run over the several Observations, which our Author maketh about the Causes and Effects of Earthquakes in general: He observeth,

That such Countries as abound much with Fossil-coals, as *England*, some Parts of *Germany*, and even *Sicily* itself, are more subject to Tremblings of the Earth, than any other.

That pestilential and other Diseases, which frequently follow great Earthquakes, are rather to be ascribed to noxious and infected mineral *Effluvia*, which upon such an Occasion issue out of the Earth through the several Openings, than to the Putrefaction of dead Bodies, which perish'd in the Earthquake, and were buried under the Ruins of destroyed Buildings.

That amongst the Minerals hidden in the Entrails of the Earth, some are combustible, some not; that of the combustible Ones, as Sulphur, Bitumen, Alum, Vitriol, Salt-Petre, &c. some take Fire quicker than others; that others, as Coals, are with greater Difficulty



culty to be inflamed, but keep the Fire so much the longer; that the Heat and sulphureous Smell of the Waters, which broke first through the Openings of the Earth, probably depends upon the Mixture and Fermentation of some of these Minerals.

That *Baccius*, *Kircher*, and others, which draw the Origin of the above-mentioned sulphureous Lake near *Mena*, and of several others in other Places from the subterraneous Cavities of the Mountain *Ætna*, are much in the wrong, there being not the least Necessity of it's being derived so far, since the Country every where abounds with combustible Minerals, which rather seem to entertain and nourish the fiery Eruptions of *Ætna*, than to be occasioned by them.

That the Sea's retiring from the Shore, and sinking down, is the less to be wondered at, since there are many Examples in Histories of whole Towns and Islands swallowed up by it. This Misfortune befel, according to *Pliny*, *Tyndarida*, formerly a famous City in *Sicily*.

That in all probability *Sicily* itself, which, by the Testimonies of *Diodorus Siculus*, *Strabo*, *Pomponius Mela*, *Plinius*, *Solinus*, *Justinus*, *Seneca*, and several others, both antient and modern Authors, appears to have been formerly annexed to the Continent of *Italy*, by a small Neck of Land between the Cape of *Messina* and the lower Parts of *Calabria*, was separated from it by some violent Succussion of the Earth.

That the ignivomous *Ætna*, far from being the Cause, as some imagine, of the Earthquakes, which so often desolate the Kingdom of *Sicily*, seems rather to have been created by the allwise Providence, in order to secure this Island by it's fiery Eruptions from more frequent Misfortunes.

That contrary to what *Aristotle* and some others assert, solid and rocky Places receive infinitely more Damage by Earthquakes, than loose, sandy Grounds. This appears by the Ruins of *Catania*, *Leontini*, *Agosta*, *Syracusa*, and *Noto*, which were all built upon a solid stony Ground, whereas *Messina*, though every where undermined by subterranean Cavities, was abundantly less shaken.

The remaining Part of the Book is employed about examining the Opinions of all the antient and modern Philosophers about the Causes of Earthquakes, and establishing the Author's own, which is, that the Earth is shaken by the Violence of subterraneous Fires, occasioned by the Fermentation of the combustible Minerals hid in it's Entrails, and that the Effects of the Earthquakes may in all Regards be compared to the Effects of Mines. By the way, he observeth, that the Causes of Thunder, Lightening, and Winds may be derived from the same Principle.



*An Account  
of a Book in-  
tituled, Pro-  
dromus Cry-  
stallographiæ.  
De Crystallis  
impropriè sic  
dictis Com-  
mentarium;  
à Mauritio  
Antonio Cap-  
peler, M. D.  
& Centumvi-  
ro Lucernen-  
si. Lucernæ  
1723. 4<sup>to</sup>.  
By J. G.  
Scheuchzer,  
M. D. R. S. S.  
No. 387. p.  
272.*

XXVII. The Author of this Treatise takes notice in the Preface, that it is only a small Part of a larger Work, which he promised the Public some Years ago, under the Title of *Crystallographia*, and hath now almost ready for the Press. This greater Work, as he intimates at the Close of this Discourse, is to consist of three Parts, the first of which contains the Definition of Crystal, with the Synonyms given it by several Authors both ancient and modern, and an Account of it's Properties, Figure, Pellucidity, specific Gravity, and Bigness; as also the Place of it's Growth, chiefly in regard to *Switzerland*, the most plentiful Country in *Europe*, as to this Sort of natural Productions; the Signs, whereby hidden Crystal Mines may be discovered, and the Way of working them. In the second Part will be examined the Opinions of several Natural Historians, about the Origin of Crystal, and the Author's own established and proved. In the third Part will be shewn the Uses of Crystal, both Physical and Mechanical, and some few Hints given, relating to the just Value the World has at all Times put upon this beautiful Production of Nature.

The Author divides this present Essay into two Parts, *viz.* a short Commentary upon the *Crystallos*, as he calls them, *impropriè sic dictos*, in the first; and an Account of such as he found mentioned in several Authors, with a Reduction of them under certain Heads, in the second. *Crystalli impropriè sic dicti*, according to the Author's Definition, are such Bodies, either Stones, Metals, or Salts, as have any Resemblance with the true Crystal; either, as to their multangular, regular, or irregular Figure, or as to their Pellucidity, or any other of it's essential Properties. As the Number of these Bodies is very extensive, so an exact Enquiry into them cannot but be both useful and agreeable. I just now observed, that the *Crystalli impropriè sic dicti* are taken out of Stones, Metals, and Salts. To the first belong amongst other Things such precious Stones, as, in all Probability, have their certain, determined Crystal like Figures, as Diamonds, Amethysts, &c. To the second belong all Sorts of *Pyritæ*, as also the Growth of Silver, and other Metals, in Form of Trees, or other Things. By the third are understood all Chymical Preparations of Salts, and saline Bodies, the Figure of which is, generally speaking, more accurate, than in any of the two former. Several Authors of Note have endeavoured to explain how, Crystallization is performed, or how it comes, that certain Substances shoot into Crystals. Dr Capperer mentions the Hypothesis of the learned *Gulielminus*, and that of a late *Swedish* Author, *Swedenbergh*; and though he seems more to favour the latter, than he doth the former; yet he thinks, that they are both liable to Exceptions. But whatever the Cause or Method of Crystallization be, our Author takes it for granted, that three Things are absolutely required for it, *viz.* Salt, which must always be an Acid, as is evident by Chymical Experiments, and the

very



very Taste of saline Crystals, Water and *Earth*. Crystallization, as far as can be guessed by Chymical Observations, is performed thus: Particles of certain determined Shapes, swimming in a Fluid of a certain Consistence, are, either by the intestine Motion of this Fluid, or by the Motion of the Air, supposed to circulate perpetually through it's Pores, or by some other Cause, brought together, so as to form larger Bodies of a Figure proportionable both to the Degree of Impulsion, and the primitive Shape of the constituent Parts, or determined by these two Things. This Act of Crystallization, though uniform, as to the Union of Particles considered in itself, is yet observed to be very different, and to have different Effects, with respect to the different Nature of the Fluid, in which Crystals are formed, and the Degree of Perfection, to which they are brought. Our Author mentions six different Kinds of Crystallization, each of which, he intends to explain more fully in his larger Work. The first Sort of Crystallization, which hath been examined with a great deal of Accuracy by *Gulielminus*, is performed in an aqueous Fluid, wherein saline Particles have been dissolved, boiled to a certain Degree of Consistence, commonly that of a thin *Pellicula* covering it's Surface. This aqueous Fluid must be afterwards reposed in a cool Place, that the saline Particles contained in it, may form themselves into Crystals, which is done in more or less Time, according to the different Nature both of the Fluid and Salts. All Chymical Preparations of Salts, the Origin of precious Stones, and of the Crystal itself, belong to this first Kind. Our Author observed, that in the *Spiritus aperitivus Glauberi*, (which is a Preparation of *Ciner. Clavell. p. ii. & Sal Ammon. p. i.*) after a Year's standing, formed themselves artificial Crystals, in Figure and Pellucidity exactly like the true sexangular Crystal, and pointed on both Sides. The second Kind of Crystallization differs from the first only in this, that it is performed not in a thin, pellucid, aqueous Fluid, but between thick, mineral or metallical Mixtures, corroded by acid Salts in the Bowels of the Earth. The third Sort is of a middle Kind between the first, and a Coagulation, *viz.* when the Fluid, in which Salts have been dissolved, is by degrees, entirely evaporated. This Way of Crystallization is more proper for discovering the primitive Shapes of saline Particles. Our Author hath examined several Salts, both Mineral and Vegetable, and several Chymical Preparations after this Manner, and hath given us their Figures as they appeared to him under a good Microscope, in two Tables annexed to this Treatise. The fourth Sort of Crystallization is performed in a still thinner Fluid than Water is, or in the Air; the Sublimations of the Chymists, the Distillation of volatile Salts; Snow, whose wonderful Figures hath been thought worthy the Amusement of several eminent Men; Hail, which is again of very different Shapes; Frost and that admirable Variety of Trees, Landskips, and other inimitable Figures, which, in very frosty Weather, appear



upon Glass Windows, or other pellucid Bodies, must be all reduced to this fourth Sort. The fifth Sort of CrySTALLIZATION is performed upon the Surface of a thicker Fluid, as Water, between that and a thinner one, as Air; of this Kind is chiefly Ice. The sixth and last Sort of CrySTALLIZATION, mentioned by our Author, differs from all the former, in that it is performed neither by the Rise of Vapours, nor by the reposing of any Fluid, but on the contrary in a Fluid, which is in a perpetual Motion. That Sort of icy Concretions, which is observed near swift running Waters, and is commonly very porous, not unlike the Tophus, and the stony Concretions in subterranean Cavities, called *Stalactitæ*, belong to this last Sort. Thus far what is contained in the first Part,

The second gives an Account of such *CrySTALLI improprie sic dicti*, or CrySTALLINE Bodies, which are not properly CrySTALS, as have been mentioned by several Natural Historians both ancient and modern. The Author distributed them into the following Classes, each of which comprehends Stones, Metals, and Salts.

Corpora CrySTALLISATA, quæ improprie CrySTALLI vocantur.

- Class. I. Globosa, rotundata & sphæroidea.
- II. Conica, Conoidea & fusiformia.
- III. Cylindrica, solida aut tubulata.
- IV. Pyramidalia & cuneiformia.
- V. Prismatica, Parallelepipedata, Rhomboidea, Trapezoidea.
- VI. Polyedrica, & Polygona, regularia & minus regularia.
- VII. Racemosa, Arbusculorum in modum, & filamentosa, filorum, aut capillorum instar nascentia & striatim contexta.
- VIII. Cruſtis, squamis, lamellisque contexta, sine, vel cum figura propria.
- IX. Corpora, quorum cum CrySTALLO affinitas in pelluciditate potissimum consistit, figurâ eorum nativâ, vel incertâ vel nondum perspectâ.

C H A P.



## C H A P. IV.

## M A G N E T I C S.

I. **A**FTER having given an Account of an Experiment made with the large Magnet in the Repository of the Royal Society, (which Experiment is described in *Philosoph. Transact.* N<sup>o</sup>. 344. Article 4.) the Letter goes on with the same Subject as follows. — If it were known what point within the Stone, and what point in the Needle are the Centers of the Magnetical power, it would be easy to find the true powers of the Magnet at all the distances observed. For want of that Knowledge, I have computed the Forces from the Center of the Needle, and the Extremity of the Loadstone, and find that at the distance of nine Feet, the Power alters faster, than as the Cubes of the distances, whereas at the distances of one and two Feet, the Power alters nearly as their Squares. To try whether the Law, by which the Magnetism alters, could be reduced at all distances to any one certain power of those distances, I sought those points in the Needle and Stone, which being used as the Centers of the power might have that property. But in that case, I found the Center of the Stone must be carried quite out of it's Figure, to make the distances large enough for this purpose. From whence it seems to appear, that the power of Magnetism does not alter according to any particular power of the distances, but decreases much faster in the greater distances, than it does in the near ones.

*An Account of  
some Experi-  
ments relating  
to Magnetism,  
by Dr Brock  
Taylor, N<sup>o</sup>.  
368. p. 204.*

This seems to be confirmed by other Experiments I made. The first Experiment was thus; I made a Needle  $\frac{3}{4}$  of an Inch long, of very fine Steel-wire (a Foot length of which weighed but a Grain), which I lengthen'd by sticking a light piece of Rush to it, so that I could observe the Direction of the Needle in all the trials with a Radius of two Inches. Instead of a Magnet I used a touched Needle of Steel-wire, which I set on a perpendicular to the Horizontal Plane I made the Observations on, by means of a Frame I made to transport it from one place to another; the North end of the Needle being placed downwards, and made a little sharp, that it might mark the Paper it was set upon in every position, by pressing the top of the Needle gently with the Finger. The Observations were made in this manner; after having taking notice of the natural direction of the small Compass Needle, I brought the perpendicular Needle as near to it as I conveniently could, setting it in such a manner, that a Line from the upright Needle to the Center of the Compass might be perpendicular to the Compass Needle. Then observing the same caution



(which was convenient to make the Center of the Compass serve sufficiently well to be esteem'd it's Center of Power) I placed the upright Needle at several greater distances, every time marking the place in the manner already described, and observing the Variation of the Compass. By this means I got a Curve pretty regularly and fairly drawn by points on the paper. And by examining this Curve, compared with the Variations of the Compass corresponding to it's respective points, I found that the Magnetical power decreased faster at the greater distances than at the nearer. It is of little use to be very particular in the account of the several Observations. I shall only take notice, that at about two Inches and a quarter distance the Force did not alter so fast as the Squares, and at ten Inches distance (where the Variation was one degree only) it altered faster than the Cubes, the Index of the Power being about  $3\frac{1}{4}$ . The Needle of the Compass was so short, that to suppose it's Center of Force to be either in the middle or at the extremity of it, would not alter the Index of the Powers of the distances  $\frac{1}{20}$  of an Unit.

I made another Experiment to the same purpose, with a Compass Needle made of a slight piece of Straw, with a small piece of Steel-wire fastened to one end of it, which was always kept in the same position, being balanced between two perpendicular Needles, one of which was moveable, and the other fixed. The Event was much the same as in the former Experiment.

Endeavouring to find the true Poles, or Centers of the magnetical Power in touched Needles, I made a Needle of two Inches long, of the fine Steel-wire, which I touched with the South point of a small cap Loadstone, applying the point of the Cap only to the Extremity of the Needle, without drawing it along. The Needle so touch'd being laid gently on the Surface of a stagnant Water, floated. I then applied to it successively the two ends of a touched Needle, as near as I could, without letting the Needles touch. The result was, that the floating Needle rested under the respective Poles of the other Needle marked with the small Letters *s*, *n*, *s*. So that by one Touch with the Loadstone, which gave the Needle a North-pole at *N*, where it was touched, it acquired three other Poles, *s*, *n*, *s*, which we may not therefore improperly call it's consequential Poles. Having discovered these consequential Poles, I made some other Experiments to discover more of the Nature of them, as they are described in the Scheme. The Needles were all of them two Inches long, made of the same fine Steel-wire, and the Letters *N*, or *n*, and *S*, or *s*, denote Character, of North or South belonging to the points marked; the great Letters signifying the points the Loadstone was applied to, and the small Letters shewing the consequential Poles.

Fig. 87.

There



There are two other Experiments described in the same Letter, relating to the Attraction of Fluids, one of which (*viz.* that of the *Hyperbola*, made by the Surface of the Water between two Glass-planes) being already described in the *Transactions* (N<sup>o</sup>. 336.) we shall only transcribe the Account given of the other.

I took several very thin pieces of Fir-board, and having hung them successively in a convenient manner to a nice pair of Scales, I tried what Weight was necessary, (over and above their own, after they had been well soaked in Water) to separate them at once from the Surface of stagnating Water. I found 50 Grains to separate a Surface of one Inch square; and the Weight in every trial being exactly proportional to the Surface, I was encouraged to think the Experiment well made. The distance of the under Surface of the Board from the Surface of the stagnating Water, at the time they separated I found to be  $\frac{16}{100}$  of an Inch; though I believe it would be found greater, if it could be measured at a greater distance from the Edge of the Board, than I could do it, the Water rising a little before it came quite under the Edge of the Board.

II. *Primum* volui experiri an magnetes in se operarentur juxta certam proportionem in diversis distantis, vidique in Actis Britannicis, N<sup>o</sup>. 335. pag. 506. simile venisse in mentem experientissimo *Hauksbejo*, sed ipsum instituisse experimenta cum magnete & acu modo tali, qui omnibus non satisfaceret accuratis rerum scrutatoribus unde concludit tamen his verbis. *I see no Reason to doubt, but the Proportions of this Power will be regular, and agreeable to the several Distances.* Quæ verba non adeo placuisse omnibus Eruditis colligo, cum Nobilissimus *Taylor* eadem experimenta repetiit, N<sup>o</sup> 344. pag. 294. & alia reliquit observata.

Of Magnetical Powers,  
by P. Mufchenbroek,  
M. D. N<sup>o</sup>.  
390. pag. —

Rem eandem aggressus fui methodo prorsus diversa, sic meditatus, si fumerem duos magnetes, & unum Suspenderem ex filo supra alium, ad diversas distantias à se invicem, sique fili extremum annecterem bilanci, me ponderare posse quantitatem virium, quibus magnetes in se agebant; neque successu caruit meditatio. Sumpsi accuratissimam bilancem, qua melior nullibi forte exstitit, & uni brachio annexui lancem, alteri filum longissimum plurimorum pedum, cujus parti inferiori adhærebat magnes nudus; filum longissimum feci, ne actio magnetis ulla in ferream libram turbaret experimentum; ideoq; selegi locum in quo ferri tam parum, ac in ædibus unquam seligi potest. Sumpsi præstantissimos magnetes perfecte sphæricos, terrellas vester *Gilbertus* vocavit, horum poli erant accurate in extremo utroq; axeos sphæræ, ita accuratissime distantias amborum polorum mensurare poteram. Gravitationem magnetis primo reduxi ope ponderis in altera lance in æquilibrium; dein ambos magnetes posui infra se, & quia libra erat, ope funis, mobilis supra trochleam, eam demittebam ad diversas distantias pro lubitu, & cum magnes suspensus ageretur deorsum attractus vi magnetis inferioris, semper imponebam tantun-

dem



dem ponderis alteri lanci, donec vis magnetis cum pondere faceret æquilibrium: hæ tamen distantiae mensurari non possunt, nisi interponendo corpus cupreum tantæ longitudinis ac est distantia inter ambos magnetes, ob oscillationes libræ, & quia in majoribus distantiiis magnetes minus operantur, quam in minoribus distantiiis, æquilibrium libræ obtineri non potest, nisi eo artificio. Ecce nunc tabulam continentem experimenta in diversis distantiiis pollicum & linearum, columna remotior continet grana quæ æquiponderant cum attractionibus in iis distantiiis.

Distantia		Grana	
Poll.	Lin.	attractionis.	Lin. Gran.
13 —	6 —	0	8 — 106.
12 —	0 —	0 $\frac{1}{20}$ .	7 — 114.
11 —	0 —	0 $\frac{1}{8}$ .	6 — 131.
10 —	0 —	0 $\frac{1}{4}$ .	5 — 146.
9 —	0 —	0 $\frac{1}{2}$ .	4 — 172.
7 —	6 —	1 $\frac{1}{2}$ .	3 — 190.
7 —	0 —	2 $\frac{1}{2}$ .	2 — 215.
	12 —	70 $\frac{1}{2}$ .	1 — 250.
	11 —	78 $\frac{1}{2}$ .	$\frac{1}{2}$ — 290.
	10 —	87.	0 — 340.
	9 —	94.	

In ipso contactu,  
five

Pollices sumsi Rhenolandicos, & grana sunt pondera nostra medica, quæ etiam summa acribeia prius examinavi, ut essent vera & æque gravia.

Hæc experimenta institueram die 24 Decemb. 1724. & animo adeo ad omnia attento ne hallucinarer, ut vix speraverim melius fieri posse.

Sed an ex his colligere possumus ullo modo dari proportionem inter vires & distantias? ego non video.

Postquam eo usque perrexeram, suspicabar an non forte suspensus magnes esset heterogeneus utcunque, & an alius ejus substitutus loco eventum quoq; non daret magis prosperum, saltem ex quo plus lucis caperem, tædiosa enim nimis fuerant hæc experimenta quam ut inde tam parum emolumenti colligerem; sed ecce quid cum alio magnete parvo, admodum præstanti, observare datum fuit, dum magnes rotundus alius inferior idem maneret, firmiter in mensa positus: eodem autem modo experimenta instituta fuerunt.



Distantia		Grana	
Poll.	Lin.	attractionis.	Lin. Gran.
5	— 10	— 1 $\frac{1}{4}$ .	7 — 33.
4	— 6	— 2 $\frac{1}{4}$ .	6 — 38 $\frac{1}{2}$ .
3	— 9	— 3.	5 — 43 $\frac{1}{2}$ .
2	— 4	— 9.	4 — 50 $\frac{1}{2}$ .
1	— 9	— 12.	3 — 62.
1	— 0	— 23.	2 — 79.
	11	— 23 $\frac{1}{2}$ .	1 — 140.
	10	— 26 $\frac{1}{4}$ .	$\frac{1}{2}$ — 186.
	9	— 29.	0 — 340.
	8	— 30 $\frac{1}{4}$ .	

Sed irregularitates hic iterum adfunt maximæ, ex quibus concludi potest nihil: id solum est mirandum, quod dum magnes pro hoc secundo experimento fuerat minor, quam qui primo inserviverat, tamen in mutuo contactu viribus æqualibus attrahebatur, nempe 340 granorum; dum in aliis distantis longe minus tamen attracta fuit, uti ex comparatis ambabus tabulis patet: sed præterea hic minor magnes secundi experimenti multo generosior fuit & præstantior ad elevandum ferrum, quam magnes primi experimenti.

Hæc experimenta repetii cum aliis magnetibus & imprimis cum aliquo, cujus tanta vis ut acum magneticam inflectat, quæ distat ab ipso 14 pedibus Rhenolandicis; nescio an similis descriptus ullibi habeatur: sed ex omnibus id modo concludere possum experimentis, proportionem inter vires & distantias dari nullam.

Quum tam declinatio, quam inclinatio acus magneticæ variat singulis annis fere, subiit quoque desiderium videndi, an vis magnetis omni die esset eadem, an minor vel major æstate quam hyeme; sed vim esse minorem æstate quam hyeme, me docuerunt experimenta multa saltem de hac æstate loquor, an futuro anno idem obtinebit, explorandum erit.

Sumsi igitur magnetes binos, qui primo experimento inservierant, & eodem prorsus modo institui experimenta cum iis, ac ante, dies vero fuit 11 Julii 1725. cum Baroscopium esset elevatum ad  $29 \frac{5}{24}$  pollic. Thermoscopium *Fahrenbeytii* ad 62 grad. & Ventus *Noordten Westen* sive Septentrionalis versus Occasum, cœlum ficcum, ferenum & in eodem loco mearum ædium.



Distantia		Grana æqualia		
Poll.	Lin.	attractioni.		
12	—	0	—	0
9	—	0	—	1 $\frac{1}{8}$ .
8	—	0	—	1 $\frac{1}{2}$ .
7	—	6	—	2.
7	—	0	—	2 $\frac{1}{2}$ .
	12	—		70 $\frac{1}{2}$ .
	11	—		75 $\frac{1}{2}$ .
	10	—		85.
	9	—		92.
	8	—		100.
			7	— 106
			6	— 111.
			5	— 132.
			4	— 149.
			3	— 173.
			2	— 205.
			1	— 240.
			$\frac{1}{2}$	— 270.
			0	— 300.

Constat quidem inter Philosophos, magnetis utriusque polos non agere æque fortiter, sed polos boreales esse fortiores viribus quam australes, sed hoc assertum quidem, demonstratum accurate fuit nullibi; quia vero nostra methodus ponderandi vires magnetis satis facilis erat, at accurate ejus ope hoc determinari posse videbam, converti modo ambos polos amborum magnetum ita, ut iterum duo poli amici sibi essent obversi, & in magnetibus hujus ultimi experimenti hæc observavi.

Ad distant.		Grana æqual.		
Lin.		attractioni.		
12	—	57.	5	— 101.
11	—	63.	4	— 113.
10	—	66.	3	— 124.
9	—	70.	2	— 148.
8	—	79.	1	— 168.
7	—	83.	0	— 228.
6	—	90.		

Ex his patet manifesto non ambos polos magnetis agere viribus iisdem, quanta autem intercedat differentia, ex comparatione amborum tabularum videre poteris.

Quum ab ineunte ætate, qua primum operam Philosophiæ dare inceperam, in hunc usque annum mihi persuaseram actionem magnetum ab effluviis, vel aliquo saltem fluido pellente extus magnetem, pendere; neque videram præstantissimos viros aliter sensisse; experi-ri volui an ullo experimento hanc meam opinionem confirmare possem, affirmare enim effluvia vel aliquod fluidum premens extus, & non demonstrare, mihi visum fuit nimis temere conjecturis dare operam. Dum igitur experimenta priora cum magnetibus instituebam ad varias distantias à se mutuo, interposui frustra crassissima plumbi, stanni, argenti, cupri, mercurii massam insignem, visurus an hæc effluvia



effluvia magnetica non impedirentur, & si non omnino, saltem aliquo modo; vitrum pellucidum est, lucem transmittit, tamen non adeo copiosam, quam si nullum vitrum adfuisset; eodem credidi modo effluvia magnetica, si non prohiberentur omnino, saltem impediri aliquo modo ne magnetes tam fortiter ad se traherent, si plumbi frustum 1 pedis cubici interpositum foret, vel si plumbum crassitie 2 digitorum, & stannum ejusdem crassitie, tum cuprum, tum massam magnam mercurii interponerem; sed vidi, quæcunque interposueram corpora, semper vires magneticas esse easdem, ac si nullum corpus interlocaretur hoc profecto mirandum existimo, neque intellectum credo ab ullo mortalium: non enim fingere licet hæc corpora esse adeo porosa ut nihil solidi in se habeant; quod si igitur solidum habent, ut habent plurimum, an hæ partes non impedient quominus fluidum extraneum adveniat, vel ex magnete exeat; non dico quod omne fluidum impedient, sed saltem aliquid, experimenta tamen omnia docent, vires magneticas impediri nullo modo: vel an hæc effluvia erunt multo subtiliora luce?—præterquam quod hæc esset iterum hypothesis, difficultas superior non tollitur; Ignis impeditur à corporibus, lux non penetrat illico per omnia corpora, & ita se habent fluida omnia ut à solidis resistantiam experiantur, sed effluvia magnetica ita se non habebunt, immunia erunt resistantiæ à solido corporeo; hoc est, ad quod mens nostra plane hebescit.

Sed argumentum fortissimum ex viribus repellentibus magnetum depromam, sunt hæ longe debiliores, quam vires attrahentes uti mox experimentis confirmabo, adeoque oportebit ut fluidum accedat ab exterioribus versus magnetem, quod dum occurrit alteri magneti, unum pellit ad aliud, quodque magnetem ingreditur, & quia attractio magnetum est longe fortior quam repulsio, copiosius fluidum ingreditur magnetem, quam egreditur: unde fieri non potest quin brevi magnes adimpleatur hoc fluido, ut non amplius porosus maneat; nec statui potest quasi undequaque ex magnete fluidum hoc exiret, nam fit attractio in omni puncto magnetis, & fit tantum repulsio in locis polorum. Ut vero demonstrem repulsionem magnetum esse minorem attractione eorundem, ecce tabulam continentem experimenta cum memoratis ultimis magnetibus facta.



Distantia			Grana		Distantia			Grana	
Poll.	Lin.		æqualia		Poll.	Lin.		æqualia	
			repulſioni.					repulſioni.	
13	—	0	—	0.	1	—	11	—	16.
11	—	11	—	$\frac{1}{2}$ .	1	—	10	—	17.
10	—	9	—	$\frac{1}{4}$ .	1	—	4	—	17.
9	—	9	—	1.	1	—	0	—	24.
9	—	0	—	1.			10	—	24.
8	—	0	—	$1\frac{1}{4}$ .			7	—	25.
7	—	0	—	$1\frac{3}{4}$ .			6	—	$25\frac{1}{2}$ .
6	—	1	—	2.			5	—	$27\frac{1}{2}$ .
5	—	1	—	$3\frac{1}{2}$ .			4	—	29.
4	—	0	—	$6\frac{1}{2}$ .			1	—	34.
2	—	9		$11\frac{1}{2}$ .	In ipſo contactu.		0	—	44.
2	—	3		13.					

Ex his experimentis circa repulſum magnetum iterum videbis non poſſe deduci ullam proportionem, ſed proſecto magnetes eſſe corpora admodum miranda, de quibus huc uſque pauca ſcimus, ignoramus plurima.

Magnetical  
Observations  
and Experi-  
ments; by  
Servington  
Savery, Eſq;  
No. 414. pag.  
295.

PRÆCOG-  
NITA.

III. I. That which I call the Magnetical Line, is the Poſition of a Dipping-Needle when it ceaſeth from oſcillating, and is at Reſt in the magnetical Meridian of the Place.

II. By the Word Magnet (unleſs diſtinguiſhed) I would be underſtood to mean not a Loadſtone only, but either that, or Iron or Steel, when they have permanent Polarity, or any thing elſe (if to be found) which has a ſenſible magnetical or polar Attraction.

III. Of the magnetical Needle, I always call that the North End which (if hung horizontally) naturally turns to the North, and that the South End which turns to the South: But when I uſe the Words Pole of a Needle, I call that the North Pole thereof which turns to the South, and that the South Pole of it which turns to the North.

IV. Of Touched Iron or Steel (or of untouched, ſo long as it remains in a Poſture which gives it Polarity) as well as of the Loadſtone itſelf, I call that the North Pole which attracts the North End (*i. e.*) the South Pole of the Needle, and that the South Pole which attracts the South End, or North Pole of the Needle: Or in other Words, I call that the North Pole, in all Sorts of Magnets, which is endued with the ſame kind of Virtue which the North Pole of the Earth hath, and conſequently is repelled thereby: *E contra,* &c.

V. I prepared Nails of ſeveral Sizes, from the ſmalleſt Sort of Bellows-Nails to the largeſt Sort of Raſter-Nails, one or two of each Sort, or more of the ſmaller: I held each of them perpendicularly with



it's Point upwards, and placing thereon the plain Side of a File horizontally, I filed off a little from the Point thereof (more or less according to the Size of the Nail, perhaps about the Thickness of a Six-pence from a Six-penny one). Then on a plain Hone, held horizontally, I placed the Nail upright, with it's Point downward, and so rubbed off the Strokes of the File. Then I rubbed it a little on a Piece of Leather. *Note*, The truer this little narrow Plain is, and more exactly perpendicular to the Nail's Axle, the better.

VI. I prepared Iron Bars of different Lengths after the following Manner: I made each End in the Shape of the lower Frustum of a Pyramid, cut transverse to its Axis about the Middle, or a little higher up. Then I filed the Ends of the Bar as plain and perpendicular to it's Axis as I could, and polished them with a Hone, &c. as I did the Nails.

*Fig. 88.*

VII. One of the Needles I used untouched, for trying Experiments, was made thus: I took some Iron Wire, about the Size of a small Knitting-Needle, and in Length about two Inches and a half. With a Hammer I made it just flat enough in the Middle, to be able to fix the Point of a Punch pointed, to as true a Cone as I could; it's Sides (as I guess) made an Angle with each other at the Vertex of about 45 Gr. or more; in the Middle of the Wire I punched a Hole at least half Way through the Thickness thereof, and wrought the Hole with a Drill (pointed like the Punch) that it might be truly round, and cleansed off the Asperity which the Punch and Drill had raised round the Hole, lest it should injure the Top of the Pin when it was placing thereon. Then I bended it, as represented in the *Fig. 89.* figure: taking Care to bend it the right Way, that the Hole might be on the under Side. Then I marked one End, by flattening it a little with a Hammer, that it might be known from the other. Then placing it on a sharp Pin, to find which End was heaviest, I made both alike in Weight, and deprived it of all fixed Magnetism. Then I brought it again to as true a Poise as I could, by rubbing the heaviest End on a Whetstone, and not a File, which might give it Magnetism again. I fitted a Pin for it of brass Wire, full as small as the middle Strings of a Spinnet, making the Point very meagre and round as well as sharp, and observed it frequently with a Lens of two Inches Focus; and if it appeared flat, I mended it on a Hone, and took great Care in putting on the Needle, not to hurt the tender Point of the Pin. I put a Glass over it, to keep off all manner of fanning by the Air, the least Degree whereof did spoil the Experiments.

VIII. A second Needle, which I thought better than the former, I made thus: In the Middle of such a Piece of Wire as the former was made of, I wrought a Hole through it as perpendicular as I could to it's Axis, or Length, and as small as any of those which are drilled through the Pillars of a Watch, if not smaller. And having bent the



Fig 90.

the Wire as in the Figure. I marked one End thereof, and drove into the Hole a small brass Pin fitted to it, which was very round and sharp at the Point, which rested on a deep Plano-Concave Lens of Glass well polished. (*See the Figure.*) I fitted a Box for it with a Glass over it; which Glass was fastened with a Ring of brass Wire, as the Glasses of Telescopes are; which Ring kept out Air, otherwise it had been needless. The Glass Concave was fixed in the great End of a thin Brass Ferule (like that of a Staff) just fit for it, and the small End of the Ferule was fixed in a Hole made for it in the Middle of the Bottom of the Box: I also put a Ring of thin Brass on the Top of the Lens, not only to keep it in steady, but to prevent the Pin from going in betwixt the Lens and the Ferule, which spoils it's Point. Doubtless a Concave of Diamond is much better.

Whensoever I used one of either Sort of these Needles (especially for such Experiments as required it to be perfectly void of fixed Polarity) I was obliged to keep it in a Motion either librating up and down like the Beam of a Pair of Scales, or trembling (which is a short pendulous Oscillation from Side to Side) or else both librating and trembling at the same Time; which said two Motions being at right Angles with each other, are not inconsistent: And if the Needle is truly poised, the horizontal Verticity is neither obstructed nor accelerated by the Librations, because they are at right Angles therewith, nor by the Tremblings, because the two Ends perfectly balance one another in contrary Motion. The Service they do, is to abate that Friction on the Pin's Point, which retards the horizontal Verticity; for when the Friction is divided between the horizontal Verticity, and the Librations or Tremblings (either of the two latter rolling on the Pin more speedily) the far greater Part of the Friction is spent on the Librations, or Tremblings, and consequently there is but little left to retard the horizontal Verticity. I take such a Needle to be far better for my Purpose than the common ones, which have a heavy Socket of Brass, or Steel, in the Middle, useful only to render them portable, but very detrimental in nice Experiments; because the Weight of the Socket not only blunts the Pin sooner, but also encreaseth the Friction, though the same Acuteness of the Pin should be supposed to continue. To renew the Tremblings when they began to abate, I rarely jogged the Box on the Table, for fear of giving it (and the Needle within it) a circular Motion, which obstructs the Design: But I found it best to do it, by jogging the Table gently. When I had Occasion to turn the Needle to any other Point of the Compass, I elevated that Part of the Box which was under one End, until it rested on the Bottom, and in that Posture could turn it as I would; but before I could let down the Box again to a horizontal Position, I was forced to wait till the Needle was very still, and to let down the elevated Side easily, and with a direct Motion;



Fig. 76.

Fig. 77.

Fig. 78.

Scale of 12 Inches.  
3 6 9 12



Fig. 80.  
S T



Fig. 81.  
V W

Fig. 79.



Fig. 82.



Fig. 83.



Fig. 85.  
N O

Fig. 84.



Fig. 87.n

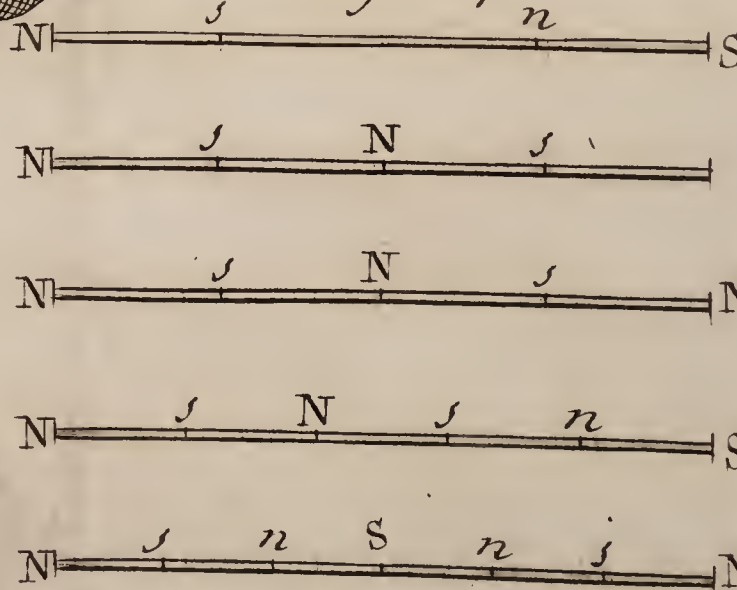


Fig. 86.



Fig. 88.



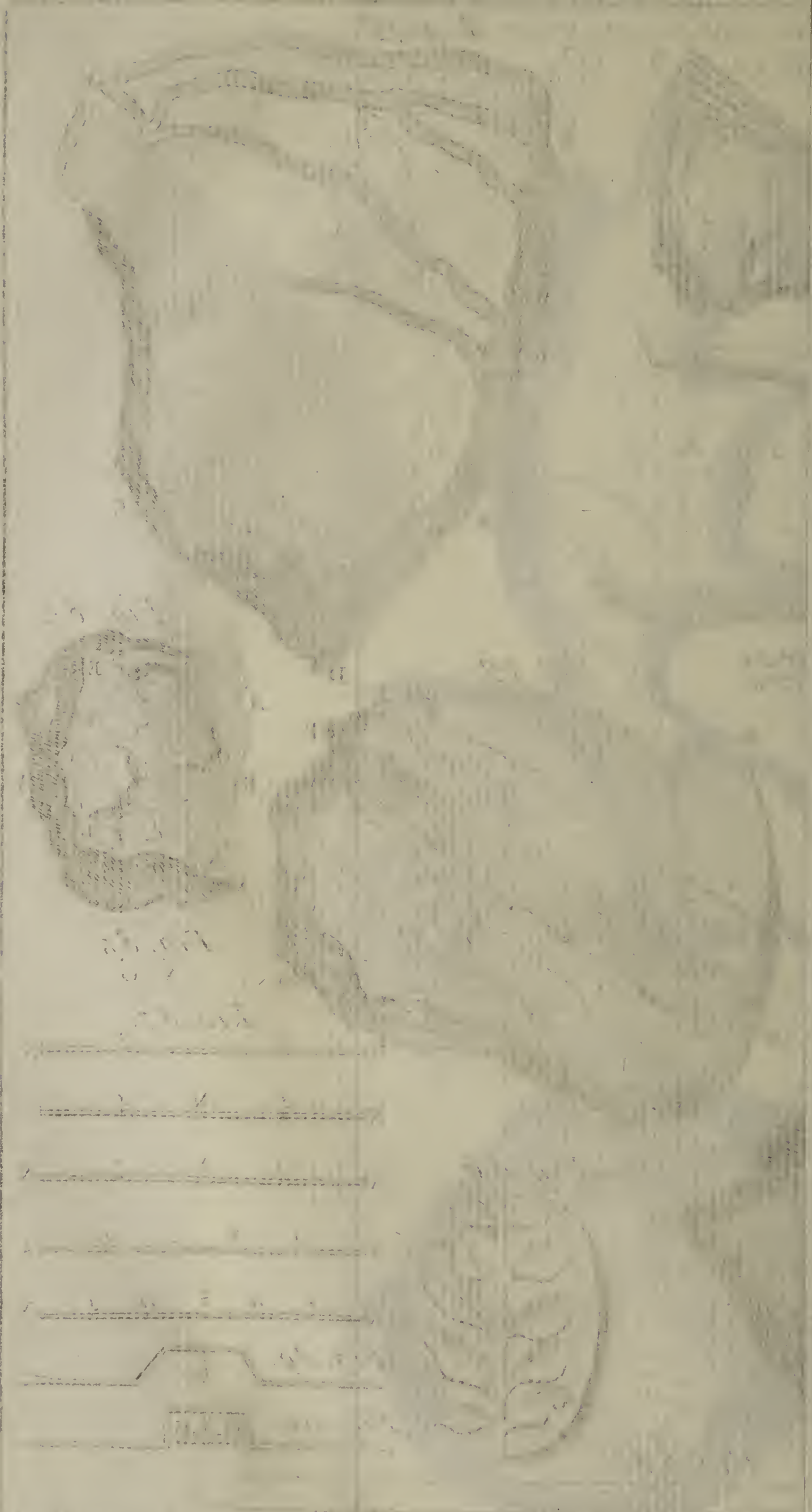
Fig. 89.



Fig. 90.









Motion; otherwise the Needle, as soon as both its Ends were free, would have more or less of a horizontal Motion.

I am convinced by several Properties of the Load-stone that there is no such thing in Nature as magnetical Attraction without Polarity *Observations.* which is constituted of Attraction and Repulsion; and these two Powers being always equally strong in the same Pole of every Magnet, I take it to be a plain Contradiction, to say this or that Load-stone has a strong Attraction, but a weak Polarity or Direction.

Every Frustrum of a Load-stone, is an entire or perfect Load-stone, having in itself both Poles as the whole Stone had; and the Poles in each Frustrum have their Direction (as near as the Figure of it will admit) in the same parallel Line wherein they were directed both in it and the whole Stone, before it was separated therefrom: For the Polarity of every Fragment is usually, if not always (before they are separated) parallel to that of the whole Stone, and consequently to that of each other: And if ever it is found otherwise, I cannot but think that Loadstone wants of Perfection.

Let  $N \Sigma \nu \sigma$ , be a Loadstone in the Form of an oblong right-angled *Fig. 91.* Parallelopipedon, whose Polarity is Length-ways,  $N$  being it's North Pole,  $e$ , the pricked Line, it's Equinoctial (or Middle betwixt it's Poles) where it has no Attraction, and  $\sigma$  it's South Pole. Let it be bisected at  $e$ , transverse to it's Polarity, or Length. Each of it's Frustra when they are placed too remote to act on each other) will infallibly be possessed of both Poles (with it's Equinoctial in it's Middle) as the whole Stone was before it's Bisection: And though originally the one Frustrum  $N \Sigma$  was all over a North Pole, and the other  $\nu \sigma$  all over a South Pole, while they adhered to one another, yet now they are divided, and placed beyond the Reach of each other's Virtue, one half of the Frustrum  $N \Sigma$  from the Place of it's *quondam* Contact  $\Sigma$ , to it's Middle  $e$ , does instantly become a South Pole, and attract strongly at the Place of Contact aforesaid, which Attraction is gradually less and less until it is abated to nothing at  $e$ . So also one half of the Frustrum  $\nu \sigma$ , from the Place of it's former Contact  $\nu$  to it's Middle or Equinoctial  $e$  instantly becomes a North Pole (gradually abating in Strength from  $\nu$  to  $e$ ) though the whole Frustrum, before it's Separation from the other, was a South Pole: The Polarity being also directed the same Way in each Frustrum that it was in it (and the whole Stone) before the Bisection. The Case also would have been the same, if the Stone had been divided unequally at  $x$ , or elsewhere transverse to it's Polarity, and of each Frustrum, one half would have been a North Pole, and the other half a South *Fig. 92.* one, with it's Equinoctial in the Middle as before. The whole Stone will lift a larger Iron than either Frustrum; but both Frustra, while out of the Reach of one another's Virtue, will each of them lift his Iron, both of which Iron, will be heavier than what the whole Stone



Fig. 93.

Stone could lift before it was divided. If the said Fruſta are again joined cloſe together at the ſame Ends which originally adhered, *Fig. 91*, being as they ſtand directed towards each other *Fig. 92*; or if the oppoſite Ends of both are joined together, as they ſtand directed towards each other, *Fig. 93*, I do not ſee (provided the Joint is very good, that there may be a Contact all over it as good as a Workman can make) why they ſhould not compoſe again one entire Load-ſtone, as good as it was before it was divided, in all Reſpects (Allowance being firſt given for the Waſte in ſawing it aſunder, and mending the Joint) and their joined Poles mutually attracting one another, attract nothing elſe at the Joint (which being in the Middle, would become it's Equinoctial) but transmitting their Virtue through one another, the Pole  $\Sigma$  of the one Fruſtum, *Fig. 92*, wholly ſpends itſelf in ſtrengthening the ſimilar Pole  $\sigma$  of the other Fruſtum, by weakening the Pole  $\nu$  thereof, & *vice verſa*. And if their Lengths ſhould be unequal, like the Fruſta of *Fig. 91*, divided at  $x$ , the Equinoctial would not be at  $x$ , where they were joined together again, but always at  $e$  the Middle of their whole conjunct Length, as it uſeth to be in one entire Load-ſtone of the ſame Bigneſs from Pole to Pole: For I apprehend if any Load-ſtone ſhould be wrought very tapering from one Pole to the other, that the Equinoctial could not be precisely in the Middle thereof, but according to what Degree of Taperneſs it is wrought to, be removed nearer to the great End: But theſe Things, for want of proper Load-ſtones, I cannot try, nor yet the following on *Fig. 94*, which represents a Load-ſtone in the Form of a Parallelopipedon right angled, in Thickneſs one Inch, it's Breadth  $af$  6 Inches; it's Length  $ac$  7 Inches or more, having it's Polarity not perfectly length-ways in it, but a little oblique, as the Shade-Lines represent it. If there is cut off from one of it's Ends  $cd$ , the Parallelopipedon  $bcd$  one Inch from the ſaid End, it will be one Inch ſquare, and ſix Inches long: I ſuppoſe this leſſer Fruſtum would have it's Polarity changed, and the Direction thereof, inſtead of running from  $e$  ſomewhat towards  $d$ , would run from  $e$  towards  $c$  in the Diagonal Line  $ec$ , or in ſome Line or other between the Lines  $eb$  and  $ec$ . I alſo imagine, that if a Cube was cut off, within a little Time after, from one End, the Polarity therein would be directed as it was therein, while all the ſaid Fruſta adhered together; but if the leſſer Fruſtum  $bcd$  ſhould long remain ſeparated from the whole Stone, before the ſaid Cube was cut off, that the Polarity of the Cube would be more or leſs fixed, and conform itſelf more or leſs to the Direction of the Line  $ec$ . However, this is certain, that if the two Fruſta are joined together, as they ſtand directed *Fig. 92*, or *Fig. 93*, with the North Pole of one to the South Pole of the other, they aſſiſt one another in lifting Iron. If joined *Fig. 95*. with the South Pole of one againſt the South Pole of the

Fig. 94.



the other, by repelling they reciprocally destroy each other's Virtue and also hinder one another's Attraction at the North Poles, which are not joined. If they are placed together, as in *Fig. 96*, though they endeavour to avoid one another, yet they do not destroy each other's Virtue so much as in the preceding Case, nor yet at all if there is a perfect Contact: For if this Posture of two Magnets actually adhering would diminish their Virtue, one Part of the same Loadstone would destroy another Part of itself, and in a very short Time there would be no such Thing as Magnetism. In this Posture they mutually help one another's Attraction, because their Polarities are directed the same Way. If they are applied, as in *Fig. 97*, with their Sides together, and their Polarities contrarily directed, the North Pole of the one (at either End) attracting the South Pole of the other, and the South Pole the North, they scarcely injure one another's Virtue by so lying together, but hinder each other from attracting other Things, by spending their Virtue on each other.

*Fig. 96.*

*Fig. 97.*

I apprehend, that though a great Magnet (I mean of such as are similar in Figure and specific Virtue) will lift considerably larger Irons than a small one, yet the small one shall give to the same Piece of Steel (provided it is not too large for it to conquer) well nigh (if not altogether, as to Sense) as strong a Touch as the great one. And I have experienced, that if the small one is specifically pretty much better, it will give the same small Piece of Steel a considerably stronger Touch than the great one can, though the great one is capable of lifting perhaps three or four Times as much as the small one. *Note*, That if the great one is so strong as to give the small Piece of Steel so much Virtue as it is capable of receiving (for there is, I suppose, a *ne plus ultra*) that then should the small Stone be ever so much better, it cannot mend the Touch given by the great one. Some write, that the Loadstone loses none of it's Virtue by communicating of it to Iron or Steel, which I somewhat doubt the Truth of, especially if the Stone is small in Proportion to the Steel, in which Case I have known touched Steel lose considerable Virtue.

Steel is not only more receptive, but more retentive of Magnetism than common Iron; Iron or Steel hammered hard, than the same while soft; but Steel hardened by quenching, than either of them. My Observation has been, that Steel cannot be seasoned too hard for Retention (nor, as I think, for Reception) of Magnetism; but may sometimes warp too crooked for it's intended Use, and must be made right again some Way or other, either with a Grinding-Stone, or (if that will not do) by heating it to a blue Colour, and gently hammering it while hot; but if it can be helped, the Temper for the blue Colour it too soft.

Not only Steel or Iron regularly touched, but also oblong Iron void of permanent Virtue (so long as it has a transient Virtue by Position of either of it's Ends towards the Pole of a Loadstone large



enough to affect it at a considerable Distance) will perform all that any Loadstone can, though not with the same Degree of Power: For either of them will attract, keep one Piece of Iron suspended to another, and communicate some Degree of permanent Polarity to Steel well hardened, as I have experienced, and also to an Iron Wire.

The Earth's central Loadstone, or Magnet, has all the same Virtues which others have, and no discovered ones besides; and though we cannot approach it, yet it acts as others do at a proportionable Distance. I have experienced, that it will keep a prepared Sixpenny (or with more Difficulty a Ten-penny) Nail suspended to a prepared Iron Bar about  $\frac{7}{8}$  of an Inch square, and 5 or 6 Feet long, in an erect Posture with either of it's Ends downwards. I hung up the Bar in a Room by a Loop of small Cord fastened at the End which was upwards; I then carefully wiped the lower End of the Bar, and the Point of the Nail, that there might be no Dust, or Moisture, to prevent a good Contact, taking Care not to touch either of them with my Finger, lest Perspiration should sully them. Then holding the Nail under the Bar very erect, with it's Point upwards, I kept it close to the Bar, by only one Finger held under the Head of it, for the Space of 30 or 40 Seconds or more. Then I withdrew my Finger very gently, and directly downwards, that the Nail might not oscillate; and if it fell off, I wiped it's Point as before, and tried it again at some other Part, of the Plain at the Bottom of the Bar; for I always found it would more readily hang at one Place than another and usually the Middle was not so well as towards one of the Edges or Corners, and the Success better nigh one Edge or Corner than another. If both Ends of the Bar are equal in Bigness, and the Preparation of their Ends similar, it is indifferent which End is downward, if it has no permanent Virtue: But if it has no more than an inchoate or imperfect Degree of fixed Polarity, one End will answer better, and the other worse, in Proportion to the Degree of imperfect Polarity which it has.

Of a soft Iron Bar void of fixed Polarity, so soon as it is in an erect Position, the higher Part from the Middle upward becomes a North Pole in North, or a South Pole in South magnetic Latitude. And, *a contra*, the lower Part from the Middle downward becomes a South Pole in North, and a North Pole in South Latitude: But so soon as ever the Bar is inverted, the Polarity will be shifted in it, and in North Latitude the End newly placed upward becomes the North Pole, though it was a South one immediately before, and the other End the South Pole, though it was it's North one just before. The Case is the same, if such a Bar is placed horizontally in or near the magnetical Meridian; for the End directed toward the North will constantly be a South Pole, and that which is directed toward the South, a North one; and so soon as ever the Ends of the Bar are shifted, the Polarity, in respect of the Bar, is shifted also (but not in respect



respect of the Earth) for which Reason this Virtue is called Transient, and is communicated by the Earth's central Magnet in such Manner as other Loadstones are said to do.

Since in North Latitude the North Pole of the Earth's central Magnet not only gives the Virtue of a South Pole to that End of a Bar which is nearest to it, but also helps it to lift Iron when neither the Bar nor Iron lifted has any permanent Virtue; the said Magnet must therefore necessarily help the South Pole of any Loadstone or Touched Steel in lifting Iron, but hinder it's North Pole. This agrees with common Experience, the North Pole of a Magnet being unable to lift so much as it's South one in North Latitude, but more in South Latitude.

This plainly shews the Reason why an armed Magnet, when both of it's Poles are applied to a Piece of Iron, will lift several times as much as with either Pole single. For the North Pole of the Magnet by sending it's Virtue through the attracted Iron, powerfully helps the South Pole of the said Magnet in attracting. Again, the strengthened South Pole must more powerfully increase the Attraction of the North Pole: And since the Poles mutually assist one another's Attraction, with a Power much greater than if they themselves are not assisted, the conjunct Poles must necessarily lift at least twice as much as both of them can lift separately. I once tried, and found the South Pole armed to lift 1125 Grains, and both Poles united 5760 with a little more Difficulty. The Ratio is about 1 to a little more than 5.

If a Bar of Iron or Steel (not having the least Degree of fixed Virtue) is placed in any Posture (except at, or near to a right Angle with the magnetical Line) it will not only for the present receive a transient Polarity thereby, but if it so remains long enough, the said Polarity will gradually become fixed or permanent, more or less, according to the Hardness or Softness of the Bar, Time it has remained in that Position, Angle it's Length makes with the magnetical Line, and Proportion of the Length thereof to it's Bigness, the longest (*cæteris paribus*) usually receiving most Virtue: And sometimes when all these Advantages concur, the Polarity will be sensibly permanent in a little Time, and not require a very long Time to be rendered pretty strong.

By placing the said Bar afterwards in the same Position, only with it's Ends shifted, it will gradually lose it's gained Magnetism, and at length have it's Polarity changed.

Mr Boyle found one of his Loadstones much impaired by lying long in a wrong Posture; I suppose he meant a repelling one, with it's North Pole towards the North Pole of the Earth. Also by applying one Pole of a very small Piece of Loadstone to the same Pole of a large one, he soon changed the Polarity of the former, but could not effect it on a Piece of any considerable Bigness, though



he tried some Hours. I have changed the Polarity of a small Fruustum of Load-stone suddenly, and without a Contact, by holding one of it's Poles nigh the same Pole of a Piece of Touched Steel much less than a common Case-Knife, at above  $\frac{1}{8}$  of an Inch distant, which would make the Fruustum leap to it. I repeated these Changes frequently with the same Fruustum.

From this, and some of the preceding Experiments, I conclude, that if two parallelopiped Load-stones equal in Magnitude and similar in Substance, Figure, and Virtue, are placed close together as in *Fig. 95* with the North Pole of the one directed against the same Pole of the other, or with the South Pole of the one against the South Pole of the other, and the Direction of their Polarities magnetically East and West, they will, by Repulsion, (as it were in a Duel) reciprocally destroy one another in an equal, though long Time: But if they are placed (in the same Situation in respect of one another, *viz.* North Pole against North Pole, or South Pole against South Pole) with the Direction of their Polarities in or near to the magnetical Line, that Stone (in North Latitude) whose South Pole stands directed to, or pretty much towards the attractive Point of the Earth's central Magnet receiving Assistance therefrom, will not lose Virtue so fast as the other, and consequently never lose all it's Virtue till it has perfectly destroyed the Polarity of it's Antagonist, which it will do in less Time, and afterward give it some Polarity again contrary to what it had at first.

Though Fire destroys fixed Magnetism in Steel or Iron, yet if they are set to cool in an erect Posture, or rather in the Direction of the magnetical Line, they will gain more or less fixed Virtue by the Time they are cold; but especially Steel heated to a seasoning Height, and in that Position cooled suddenly under Water, which I have found to fix it's Polarity so thoroughly, as that with it's North Pole held downward, it would attract the North End of a Dial Needle.

While a Piece of Iron of some Magnitude is held at one Pole of a Load-stone, it will increase the Attraction of the other Pole thereof, and enable it to lift somewhat more.

If either Pole of a Magnet large enough, toucheth one End of an oblong Piece of Steel (not too big and long for the Magnet easily to act on) it will transmit it's own Virtue to the other End of the Steel which is farthest off, and make it a Pole of it's own Kind, whilst the End which touches the Stone has Virtue of the contrary Pole: But the Virtue usually is not so strong in the End which is untouched, as in that which is; though I do not know but in some Time it may gain more, and the other lose some, until the Virtue in each End is nearly equal.

Not only a touched horizontal Needle, which has permanent Polarity, will endeavour to conform itself to the magnetical Meridian,



but also one that has no other than transient Virtue, and is with the greatest Care freed from fixed Magnetism (if made and used as in the *Præcogn.*) will do so too, though with this Difference, that which End soever happens to be placed nearest towards the magnetical North will faintly turn thither; and if that End is not suffered to remain so too long, then the other End, placed nearest to the North, will turn thither as the first did. In trying this Experiment, I sometimes found, that when the Needle had rested in the Meridian only a few Minutes, it gained a perceptible permanent Virtue, so that it's other End would not be attracted to the magnetical North, unless it was placed considerably nearer thereto than I had placed the first End; and having so stood some Time, lost again the said inchoate Permanency, and received Polarity, the contrary Way. Once, while I dined, and sat but a little Time after, I could not make the End which I left towards the South, to stand towards the North, unless I placed it very true in the Meridian; so that I was forced to free it again from Magnetism before I could use it to repeat the same, or try the following Experiment; for the least Fixedness of Polarity in the Needle would more or less obstruct both.

At the magnetical East or West of the Needle's Pin, so nice as I could guess it, I held at a great Distance, either the South Pole of a Loadstone, or lower End (which is the South Pole) of an erected Bar (both of them answered alike) and gradually approached it nearer, in a direct Line, toward the Pin, until it began to attract the Needle, which I observed was as I expected at the South End: I then changed the Ends of the Needle, and gradually approached the South Pole of a Magnet as before, and constantly found it to attract that End which was toward the South; and the North Pole of the Magnet, after the same manner, would attract the North End of the Needle when it had only transient Virtue.

I remember, that in my younger Days I once diverted myself with making a horizontal Needle, and a Dial-Box for it, one of my School-fellows having a Load-stone. Before I could have the Use of the Stone, I often held my Needle within it's Box, sometimes with it's intended South End towards the Bottom of a Window Bar, (having lately seen one of my Companions try it with his Pocket Needle, which was touched) and at other Times I would hold the Needle's North End at the Top of the Bar. I observed the Needle, which was hung very tender, to make Vibrations at either End of the Bar. I happened to set it down in the Window at a good Distance therefrom, and found the South End more inclined to vibrate to the Bar's Bottom than the North End, and seeing it to have some Virtue, I thought of encreasing it by taking the Needle out of the Box, and applying it to touch the Bar with it's proper Ends. By this Method alone it gained such a Degree of Polarity as would constantly



stantly turn it's proper End to the North, if it was kept trembling; but if I placed it's contrary End to the Bar, the Polarity would be changed presently. By this Way of Management I could give it but a faint Verticity, which was soon more vigorous when I got the Use of the Stone, though it was small, and not of the best, and the Needle soft Iron. And this was all, at that Time, I knew of Magnetism, having never read the particular Properties of the Stone, nor seen one before, nor heard of the untouched Needle's Verticity, or it's vibrating to a Bar.

Having within the Space of a few Years past had a fresh Inclination to make some magnetical Experiments, amongst other Thoughts the above-mentioned came into my Mind, That Iron, not having any fixed Polarity at all, might (if it moved tenderly enough) conform it's Ends to the magnetical Meridian; which at length put me on making such Needles as are described in the Beginning, of which either Sort answered my Expectations above-mentioned. Afterwards I touched one of the first Sort of Needles (described *Præcogn.* 7th, whose Length was  $2\frac{5}{8}$  Inches, and Weight 3lb and Gr. ij) on a Piece of transient Iron (made for Armour of a Magnet) which measured in Inches each Side of the broad plated Part about  $1\frac{5}{8}$ , the parallelo-piped Part in Length 2, and in Breadth (equal to it's Thickness)  $\frac{3}{8}$ . So it's whole Length was full three Inches and  $\frac{5}{8}$ . It's Weight Troy was 3iij 3ij. This held with it's Length directed in the magnetical Line, gave the said Needle Virtue enough to vibrate about four times in one Minute. I held the Needle, while touching, in a horizontal Situation, with it's North End directed towards the North, and placing it's Middle about the Top of the Iron, drew it along Southward. Likewise placing it's Middle about the Bottom of the said Iron, I drew it Northward, that the South End might be touched as well as the North. I afterwards touched it my new Way (hereafter mentioned) with the said Piece of Armour, and a small Piece of transient Iron, which made it vibrate about six times, and I believe it would have made more Vibrations, had the Needle been hardened Steel.

Having no other than a small Load-stone of a very irregular Shape, I was loth to diminish it enough to bring it into a tolerable Figure to receive Armour, but did only grind a little Place plain at each Pole, where I bound it on with Thread when I had ground it. The Weight thereof naked was but 3vij 3ij Gr. vj; it's armed South Pole would only lift 3vij 3lb Gr. iij, which was a Key. They not knowing where to get a better, made me think of improving what I had. I considered, that since a larger Stone of the same specific Virtue would lift more; it might possibly communicate more Virtue than mine could to the same Piece of Steel, but could not fail of so doing to a much greater Piece; and having observed that touched Steel would communicate some Virtue as well as attract, I got some Steel Wire



Wire (the largest in the Shop where I could meet with any) which having cut into equal Pieces, and filed their Ends so transversly as I could, and very plain, I made a Standard with a Plate of Iron, into which I could but just thrust the shortest; and filing all the rest till they would but just enter the said Standard, I reduced them nicely to the same Length. Then having marked one End of each of them with the Edge of a File, I seasoned them very hard, and made them, Ends and all, very bright. Each of them measured in Length about 2.74 Inches, and weighed 36 Grains or more. I weighed one of them, and they were all of the same Piece of Wire, therefore could not differ much in Weight. With my Loadstone I touched 37 of them, one by one, making their marked Ends their South Poles. I laid them Side by Side at about half an Inch Distance from one another on a Board, with their marked Ends toward the same Edge thereof, and took Care that they should not touch one another after they came from the Stone, before they were all of them touched thereon. Then having Thread and Armour made as in the Figure (one Piece marked, which I applied to the marked Ends of the Wires) in a readiness, I speedily thrust them together into a Bundle, and casting the Thread 2 or 3 times round them with my Fingers I formed the Bundle into a regular Hexagon as soon as I could, and then bound them fast from End to End, and bound fast the Armour. I took the Number 37, because that would form a regular Hexagon at each End, and so will also 19 or 7. Finding this artificial Magnet exceed my natural one, I held the Artificial in one Hand, and the Natural in the other, the North Pole of the one against the South Pole of the other, and placing their Armour on the Middle of one of my Wires, drew the Magnets asunder, and so touched both Ends of the Wire at the same Instant. In that manner I touched one by one a second Set of Wires, which I managed like the first, and bound on the Armour of the first Set to the second. The South Pole lifted a Key, Weight *Troy* 3ij 3ij 3ij Gr. v. Both Poles united would, with Difficulty, lift the said Key with Weights fastened to it, the whole 1lb *Troy*. I next tried with 19 Wires, for which I made Armour of a proportionable Size; but that did not answer so well, I thought, as 37, though I repeated the Touch. Afterwards I took 7, which I thought performed according to it's Quantity as well as the 37. Therefore I ever after used the Number 7.

*Fig. 98.*

In the next Place I thought of mending this Way of Touching, by placing all the 7, or more of them, with their marked Ends toward the North in a long small Trench, whose Depth was just fit for one of them, to keep it from rolling away while I was touching it and it's Fellows. The North End of one touching the South End of the other, and adhering by their magnetic Virtue, I placed the two Magnets, as before, at their conjunct Middle (not letting them re-

main



main there a Moment) and then instantly and speedily drew one Magnet to one End of the Wires, and the other Magnet to the other End of them; by which Method I touched them, as it were all at once, and as if they had been but one entire long Wire. I found this Way not only more expeditious, but more advantageous, giving all of them a stronger Touch: But the Wire at each End was not so strongly touched as the rest; therefore I placed more Wires in the Trench than I had Occasion for, and laid aside those at each End, whose Virtue was weaker. One of these Wires, when it was thus newly touched, would lift a prepared Nail 4.75 Inches long, in Weight *Troy* 3vij Gr. vj or vij (*i. e.*) more than 426 Grains, The Weight of the Wire can be had in that of the Nail 11.83 $\frac{1}{2}$  times. I placed all the 7 separately in the magnetical Line for about two Days; in which Time all of them had lost some Virtue, yet one of them would with Difficulty lift the Nail aforesaid, which it lifted somewhat easier just after the Touch; and that which had lost most Virtue, would easily lift a Nail of 4 $\frac{1}{2}$  Inches long, in Weight 306 Grains.

Fig. 99.

Having such Success, I got seven round Bars of Steel to be made, from End to End of one Size, so that they would but just go through a Hole made on Purpose in a Plate of Iron, and tried their Lengths in a Standard as I did the others, and marked one End of each of them with the Corner of a File in this Manner, that I might be able to see the Mark when they were bound together, lest either of them should be placed with it's End the wrong Way. Their Diameters were about  $\frac{3}{8}$  of an Inch, and their Lengths about 12 $\frac{1}{4}$  Inches good Measure. I hardened and cleansed them as I did the Wires, but one of them happening to break by a Fall in touching, I got it supplied, and, for Fear of such another Accident, reduced them to almost a blue Colour. I laid them one after another in a Trench planed for them, in a long Piece of Wood about the Depth of half their Diameter, putting their marked Ends all one Way: I made a Hole in the Trench a few Inches from one End of the Piece of Wood, and put a Pin in it to keep the Bars from sliding to the Ground, and elevated the other End till it was, as I guessed, in the magnetical Line. I then touched them with two of my Magnets as before, and this I found the best Way of all. When they were finished, and armed with proper Armour, the North Pole lifted above half a Year after 15j *Troy*, and the South Pole considerably more. In making one of these, I met with an odd Accident; for after I had begun to touch it apprehending it was a small Matter bigger than the rest, I attempted to mend it on a Grinding-stone, whose Axes were directed about 14 or 15 Degrees from East towards North, and from West towards South. I was not careful to keep it's Poles the proper Way in grinding, but held the Bar sometimes a-cross to the Stone, which would make it jar, at other times, with the North Pole toward the North



North. Afterwards I touched it again with the rest, but could not give it an Attraction equal to that of the others. I happened to try with my Dial-Needle whether the Change of Polarity was in the very Middle of the Bars, or nearer to one End than the other, and in this Bar found several Polarities contrary to my Expectation, but how many I am not certain, being several Years since, and I not heeding it nicely. As I held it erect, the Bottom was a South Pole, further up no Attraction, the Pole changing a little higher (I think one third Part of the Bar's Length) a strong North Pole, and about  $\frac{2}{3}$  up a strong South Pole, and at the Top a strong North Pole, the Middle between each Pole not attracting. Whether the jarring on the Grinding-stone while held in a wrong Posture was, as I suppose the Cause of this irregular Virtue, or whether I might at first, by Mistake touch it the contrary Way, I durst not positively assert; but all my Care and Labour would not help it by touching: For, as the Virtue became stronger in the Ends, so did also the Polarities in the other Parts of the Bar. I was somewhat concerned at this Disappointment, doubting it must have been new seasoned, which would have created the Trouble of cleansing and polishing it the second Time. I thought first that I would try to cure it by putting it over fresh Wood-Coals in a horizontal Posture, with it's intended South Pole directed towards the magnetical North, which I did, and so kept it until it was blue. Then I took it out of the Fire, and cooled it in almost the same Posture, for I think the North Pole thereof was elevated. I tried it without retouching, and found it perfectly cured, the Polarity regular throughout, and (which I was surprized at) attracted full as strongly as either of the rest.

I next endeavoured to procure Magnetism in Steel, without the Assistance of any Magnet (except the Earth's central one.)

Finding my artificial Magnets, rightly used, would communicate more Virtue to other Steel than they themselves had, and observing that erect Bars had some Virtue from the Earth's Magnet, and having also experienced that Iron, which had only transient Virtue, would, when in an erect Posture, or in the magnetical Line, give a small Degree of fixed Polarity, I ordered nine Steel Bars 0.75 of an Inch square, and 16 Inches long, to be made. Some of them through the Smith's Fault were a little less; the Weight of the heaviest was, after it was finished, 3 lb. *Avoirdupois*. I made them moderately bright by grinding, and filed their Ends as plain as I could, and transverse to their Lengths, by help of a Carpenter's Square; then marked one End of them, and, when hardened, I scowered them bright, and polished their Ends very well. I fitted a Piece of Armour for each End of one Bar, and marked the Piece which was for the marked End of the Bar, and bound fast both Pieces of Armour to the same Bar, one at each End: Then standing with my Face toward the West, and holding the Palm of my Left Hand up-



ward, I placed therein one of the Bars without Armour with it's marked End Northward, and grasped it fast at it's Middle, with my Fingers on the West Side, and the Ball of my Thumb on the East Side, where I also laid along my whole Thumb to keep it steady: So the upper Part of the Bar was open from End to End. Thus holding it, I elevated the South End thereof until I guessed it was in the magnetical Line; and holding with my Right Hand the armed Bar, with the Poles of the Armour downward, and the marked End toward the North depressed to the magnetical Line, I placed the Pole of the upper Armour about 4 or 5 Inches from the Top of the unarmed Bar, and as soon as ever it touched the Bar, I began with the greatest Speed I could make, to draw it downward until I was past the Middle, and from thence to the Bottom gradually slower. When it was at the Bottom I permitted it to rest there about 1 or 2 Seconds. After the same Manner applying the Pole of the lower Armour to the unarmed Bar about 4 or 5 Inches from it's Bottom, I drew it upward, speedily at first, slower when above the Middle letting it rest a little at the Top. Having upwards and downwards alternately repeated the Touch on the same Side of the Bar, I touched the opposite Side thereof, which was next my Hand, in the same Manner and afterwards the two other Sides. Then holding the unarmed Bar erect, I used to see if it had gained any fixed Polarity by holding my small Needle at the Top and at the Bottom of the Bar; for if it had gained any Virtue by the Touch, it would attract the Needle stronger, at the same Distance, when the marked End of the Bar was held downward, than when it was held upward. If I found it had gained any sensible Virtue I took off the Armour from the first Bar, and bound it to the second which I had touched, and after the same Manner touched the first Bar with the second, as I had touched the second with the first. And when by Trial with the Compass-Needle I found the armed Bar had communicated to the other more Virtue than was in itself, I took off the Armour and bound it to that which was newly touched, and therewith retouched that which I had disarmed. In a few Repetitions of changing the Armour from Bar to Bar, and touching the weakest, I procured in both of them (without the Assistance of either of the other seven) a fixed Polarity to such a Degree as that the North Pole, or unmarked End of either of them held downward, would attract the North End of the Needle, though much fainter than if the North Pole of the Bar had been upward, and Position did not now change their Polarities, but only weaken them: Therefore I now call their Virtue perfectly permanent. Four or five Repetitions more encreased their Virtue to such a Degree as that the South Pole of one of them would lift a Ten-penny Nail prepared, and after 2 or 3 Repetitions more a common Door Key of an Iron Box-Lock, Weight *Troy* 3j and above 3ij, not by the Bow but by it's lower End, which was wrought



wrought somewhat globular and polished. In the last Place I got a Piece of Inch Deal above three Inches broad and 7 or 8 Feet long, in the Middle whereof, at about 5 or 6 Inches from one End, I made a Hole through with a large Gimlet, into which I drove an Iron or Steel Pin, whose Length (besides what went into the Wood) was a little less than the Thickness of one of the Bars. Then I placed the biggest Bar on the said Board with it's marked End close to the Pin, and it's Length parallel to that of the Board, and with an Awl made four small Holes in the Board, one of them on each Side of the Bar about an Inch from the Bottom, and about the Thickness of a Six-pence, from it's Sides, and the other two after the same Manner, about an Inch from the Top. I drove into them Pins of large Wire half an Inch long, besides what was in the Board. The Pins were to keep the Bars from sliding out of their Places in touching. Then removing that, and placing any other Bar between the said Pins, with it's marked End close against the great Pin, I placed the marked End of the said biggest Bar close against the unmarked End of the other, and made four Holes on it's Sides, and drove Pins in them as before, and so continued to do, until the Board was full: It held half a Dozen Bars. I took Care to place the marked End of every Bar directed towards the great Iron Pin which was to keep them from sliding down to the Ground, when the other End of the Board was elevated, to stand in the magnetical Line. The Board standing with one End on the Ground, and the other leaning against the Wall, at the South End of the Room, I took the armed Bar, which had Virtue, and placed it's North Pole's Armour about the Middle of the highest Bar, whose Middle I could reach to (keeping the Armour of the South Pole a little upon one Side of the Bars, just so far as I might be sure not to touch them with that End) and then immediately drew it from thence downward to the Bottom of the lowest Bar: After the same Manner placing the Armour of the South Pole on the Middle of the lowest Bar (and holding the armed North Pole on one Side, that it might not touch) I drew it upward to the Top of the highest Bar, whose Top I could reach. And if the End of any Bar was a little under that which it rested against, I used to put a sizeable Chip under it, that the Armour might not hitch in drawing it over the Places of their Contacts. I usually touched the Bars on all four of their Sides, then took out the lowest, and (letting the rest gently slide down to the Iron Pin) placed it at the Top, that those which were first at the Top might in their Turns take their Places in the Middle, and be well touched. I commonly rested at the End of each Bar in drawing (as in the single Bar before-mentioned,) When I found those on the Board considerably stronger than my armed one, I took out that which I thought attracted best, and bound the Armour to it, putting the other in it's Room. After several repeated Touchings,

M m 2

the



Fig. 100.

the biggest of them being  $\text{liij Avoirdupois}$ , would be suspended by it's North Pole to the South Pole of one of the best of the others. They did not lift one another, or attract so well when their Ends were applied centrally, as when applied to one another (as is expressed in the Figure) near to their opposite Corners. The Line *m* in the End of each Bar represents the Manner I used to mark their intended South Poles. With one of these armed, I touched a small square Bar of Steel (placed betwixt two of the great ones) the Length whereof was 2.156 Inches, the Breadth of each Side 0.27 or somewhat more than  $\frac{1}{4}$  of an Inch) the Weight  $3\text{v. Gr. iv.}$  (*i. e.* 304 Grains) it would lift afterwards an Iron  $5\frac{1}{4}$  Inches long, weighing  $3\text{iv } 3\text{j } 3\text{j}$  or, 2000 Gr. 304 can be had 6.578 times in 2000. So it lifted above  $6\frac{1}{2}$  times it's own Weight. With this little Bar naked I touched a small Dial-Needle made of Steel (the Socket in the Middle was also Steel, and not Brass, as usual) I seasoned it very hard, and cleansed it well, and with much Care, not to break it, because so hard. It weighs not full 4 Grains, has lifted two prepared Six-penny Nails, one at each End, while it was held in an horizontal Posture with it's South Pole towards the North. It also lifted a Key by the Bow, as it was held perpendicularly with it's South Pole downwards, the Weight whereof was  $3\text{j } 3\text{ij Gr. xv}$  good Weight (*i. e.* 115 Grains or better). Wherefore since the Needle weighed less than 4 Gr. which is the 29th Part of 116, we may reckon it lifted full 29 times it's own Weight by the Force of one Pole, the Key having no permanent Virtue before.

I never saw this Communication of Magnetism outdone by the Load-stone itself, as it is commonly used; but what a good one would do, used as I did the Steel, I know not for want thereof, but doubt, unless Steel could be made better than it usually is, a stronger Degree of Attraction therein is scarce to be hoped for from the Use of the best of Load-stones.

I usually find the attractive Power in square Bars cut plain over transverse to their Lengths, to be strongest, not in the Middle of their Ends, but much nearer to their Corners or Sides, and to be greater at one Corner or Side than another; and this not only in such as are of touched Steel, but in Iron ones having no Polarity, but from their Position. The same I observed in round Bars, if their Ends are not convex.

In some of my large Steel Bars (as also in some of the round Bars) I found the North Pole strongest, in others the South. I know not the Cause thereof; for though I touched the weaker End twice as often as the stronger, it would still continue to be so, when the strongest had been well touched before. I imagine it must be owing to some Inequality of the Steel occasioned by the different Degree of Heat taken at the Forging; different Degree of Heat when the Smith desisted hammering; different Degree of Heat



in making the Iron into Steel, or Quantity of what is used in doing it; Fineness of the Iron whereof the Steel was made, some small Difference in Magnitude, or Difference in seasoning, it being almost impossible to make both Ends equally hard; but that both Ends of mine might be so, I had a Fire made long enough to heat their whole Length at one and the same Time.

I left several of the Bars on the Board whereon they were touched, and in the same Position to one another, as well as to the Earth, for some Months, to see whether they would lose any of their Virtue; but if they did, it was so little, that I could not be sure thereof.

I also tried whether what I mentioned above concerning Loadstones would hold in 5 or 6 Bars regularly touched and placed to one another in the same Manner; and found that at some of the Joinings it answered pretty well, but not so well at others, usually best at the two extream Joints, and worse at the middle ones. When I held the Dial-Needle at a good Distance from the Bars (perhaps 6 or 8 Inches) the Attraction was more regular, and the different Poles of the two Bars at their Contact was not so easily discernible; but when I held it within 2 or 3 Inches Distance, both the Poles discovered themselves more or less at every Joint. Perhaps the Cause may be the Want of a better-Contact, the Ends of the Bars not being true Planes; or it may be partly owing to their Conjunct Length (though I cannot see how that should cause it) or some Irregularity in the Virtue of each particular Bar. For it has been observed, that very oblong Iron, as Wire, is capable of having a North Pole in both Ends, and a South one in it's Middle; or, as my round Bar before-mentioned, several Polarities in no greater Length than about one Foot. My Bars were not made of *German*, but more ordinary Steel, of about 4 *d. per lb.*

IV. 1. I take this Opportunity of informing you, that the Iron-Cross, which is supposed to have stood upon the Steeple of the New-Church here about two hundred Years, having been lately taken down to be repaired, I was informed by a certain Foreign Gentleman, that a piece of Iron, that has stood for a long time in one Situation, would thereby acquire a Magnetic Quality. Upon which I desired a Workman to procure me a piece of that Cross, who accordingly brought me a bit of it, of about a Span long, and a quarter of an Inch thick, which I applyed both to a working Needle, and the Needle of the Compass, but without any Effect upon one or the other,

*Of the Magnetic Quality acquired by Iron, upon standing for a long time in the same Posture, by Mr Anthony van Leuwenhoek F. R. S. No. 371. pag. 74.*

Some time after, the same Workman brought me some other pieces, looking like rusty Iron, which he had broken off from the bottom of the Cross, where it had been fastened by four cross pieces bound down with Iron, to an erect piece of Timber nine Inches square, and covered with Lead in such a manner, that no wet could get to it.

This



This seeming rusty Iron would take up several Needles hanging by one another, and appeared to have a stronger Magnetic Virtue than two Loadstones, which I had then in the House; and was so hard, that no File would touch it. I gave one of the greatest pieces to a Knifegrinder, to grind it for me, who was a long time about it, and complained that it was harder than Steel.

*A way to communicate the Magnetical Virtue to Iron and Steel, without the help of a Load-stone, by Arnold Marcel (Nephew to the late Mr Anthony van Leuvenhoek, F.R.S.)*  
No. 423.  
pag. 294.

*Fig. 101.*

2. In the Year 1722, I observed that a long heavy Bar of Iron being set upright, and some Filings of Iron, or a Bit of Iron Wire, laid upon it's upper End, those Filings or Wire would stick to another Piece of bright pointed Iron, and suffer itself to be lifted up from the standing Bar even to the Height of five Inches.

In the Year 1726, making several further Observations about the magnetical Force, which I found in great Pieces of Iron, I made use of a large Iron Vice, about 90 lb Weight, in which I fixed a small Anvil of about 12 lb. Upon the bright Surface of this Anvil I laid the Steel, to which I would give the Virtue, in a Position of North and South, which happened to be in a Diagonal of the square Surface of the Anvil; then I took a Piece of Iron, 1 Inch Square, and 33 Inches long, of about 8 lb Weight, having at one End the Figure here represented brightly polished at *a*, and taper at the other End: Then I held fast down the Piece of Steel upon the Anvil with one Hand, and with the other I held the Iron Bar aforesaid perpendicular with it's Point *a* upon the Steel, and pressing hard, I rubbed the Steel with the Iron Bar towards me, from North to South, several Strokes, always carrying the Bar far enough round about, to begin again at the North, to prevent the drawing back of the magnetical Force: Having thus given 10 or 12 Strokes, I turned the Steel upside down, leaving it in the same Position as to North and South and after rubbing it and turning it, 'till I rubbed it about 400 times, it received by degrees more and more Strength, and at last had as much as if it had been touched by a strong Load-stone. The Place where I began to rub was always that which pointed to the North, when the Needle was hung, the End where I had ended the Stroke turning to the South. Sometimes it has happened, that in a few Strokes I gave the Steel it's Virtue; nay even in the very first Stroke one may give a great deal to a small Needle. This Way I have given the magnetical Virtue to Needles of Sea-Compasses made of one Piece of Steel, as the Figure 101, so strongly, that one of the Poles would take up  $\frac{3}{4}$ , and the other a whole Ounce of Iron, although these Needles were anointed with Linseed Oil, which made a hard Coat, to keep them from rusting, yet they kept the Virtue; but in Strengthening these Sort of Needles, I rubbed by turns first to the right and then to the left Side.

*Fig. 102.*

The same Way I brought the Virtue into the Point of a Knife, so that it would sustain 1  $\frac{1}{2}$  Ounce.

I brought



I brought the said Virtue into four small Pieces of Steel, each 1 Inch long and  $\frac{1}{2}$  Inch broad, as thin as the Spring of a Watch. These four Pieces I joined together, as into an artificial Loadstone weighing them 18 Grains *Troy*, and then it did draw up and sustain an Iron Nail, which weighed 144 Grains *Troy*: This artificial Loadstone has now these six Years been tumbled about, and been lying among Iron and Steel, and in any Position, and yet it has rather got more than lost any of it's Virtue.

The magnetical Virtue being thus brought into Iron or Steel, I have farther observed, that that End where the Stroke was begun, would draw to the North, and where the Stroke ended to the South in whatever Situation the Steel had been laid upon the Anvil to give it the Virtue. I took a Piece of Steel and rubbed it from one End to the Middle, and then from the other End to the Middle, and found it had two North Poles, one at each End, and the Middle a South Pole.

Further beginning to rub from the Middle towards each End of another Piece of Steel, I found it to have at each End a South Pole, and in the Middle a North Pole.

I have put a pretty heavy Compass-Needle after I had given it it's Virtue, into the Fire, and made red hot three times one after another letting it grow cold every time: It lost some Virtue every Heat, but at the third it had a great deal still left, and making it for the fourth time white hot, it lost it all.

When I covered the Anvil with a Piece of Woollen Cloth, and the End of the Iron Bar with a Piece of Shamoy Leather, it gave no Virtue to the Steel; then covering only the Bar, and leaving the Anvil uncovered, it gave not any Virtue that way neither: But covering the Anvil, and leaving the Bar uncovered, it gave the full Virtue.

I have tried whether my Vice had any fixed Pole by standing long in one Position, but I found it had not.

I have tried to do this with an Anvil of about 30 lb Weight, being fixed in Wood; but could not come up to the other Proofs.

I believe if one took an Iron Bar of three Inches square, and 10 or more Feet long, or several of them upon each other, and a suitable Piece or Bar of Iron to rub withal, and giving the under Part of the standing Bar the Figure aforesaid, represented by B, it might be brought to a vast Strength. *N. B.* The Steel for the Needles is always of a Spring-Temper.

I have made two Pieces of Iron, at one End  $\frac{3}{4}$  of an Inch, and so Taper to  $\frac{1}{4}$  of an Inch square each [*the Length was not mentioned*] and fixed these two Pieces of Iron to a Piece of Wood in the Shape of an armed Loadstone, at about 8 Inches one from the other, applying to the under Part of these Irons, or Legs, a Piece of Iron with a Hook to it, as to an armed Loadstone. I hung this armed Piece  
of



of Wood with each Leg over an Iron Bar (at a Distance that something might hang between them) then placed the Piece of Iron with the Hook to it to the two Feet, and I found it to draw very strongly; but my Trial was but with small Tools. I suppose if one did this in a larger Proportion, I doubt not but it would have a great Effect.

Having ground some Loadstones with Emmery, I have saved the Grinders, and mixing them with Water, so that they might easily be moved, I put them into a Bottle to sink, placing on each Side a Loadstone, one with it's North, and the other with it's South Pole towards the Bottle, and found, after the Matter was settled and dried it formed itself into a Sort of Loadstone, which had a moderate Strength, and two regular Poles.

*Explanation of the Figures.*

Fig. 101. The End of the Iron Bar, with which the Virtue is rubbed into the Steel or Iron.

Fig. 102. The Needle of a Sea Compass.

Fig. 103. The Figure of the Point, on one Side.

Fig. 104. The Figure on the Point, of the other Side.

Fig. 105. A, The Needle of a Compass. BB, The End or Edge of the Bar, with which the Needle is rubbed beginning at CC, and proceeding to DD.

*Observations  
of the Dipping  
Needle, made  
at London,  
in the Begin-  
ning of the  
Year 1723.  
By Mr George  
Graham,  
Watchmaker,  
F. R. S. No.  
389. p. 332.*

V. About the Time I was observing the Variation of the Horizontal Needle, I made likewise some Experiments with the Dipping Needle, to try, if the Dip and Vibrations were constant and regular. The Needle I made for this Purpose was 12 Inches and one Tenth long, half an Inch broad in the Middle, but not above one Tenth near the Ends; the Ends themselves being filed to fine Edges; and in Thickness it was about one Third of a Tenth. The Ends of the Axis, upon which the Needle turned, were very smooth, and not bigger than was necessary for the Support of the Needle, which weighed nine Pennyweights twenty one Grains, or about half an Ounce Troy. The Ends of the Axis were placed upon the Edges of two thin Plates of Steel, that were hard and well polished, and parallel to the Horizon, that the Needle, when vibrating, might roll, and not slide upon the Edges of the Plates, to avoid the Friction they would have been subject to, by moving in Holes. A Brass Semicircle was provided, and from the lowest Point graduated each Way and a few of the Degrees, about that Part of it which answered to the Dip, were divided into six equal Parts. By the Help of Screws, the Semicircle could be brought to a due Situation; and by two spirit Levels, placed at right Angles to each other, any Change of Situation was easily perceived, and by the Screws it could be readily restored to it's former Position; all was inclosed with Glafs to secure



secure the Needle from being disturbed by the the Motion of the Air. I must here take Notice of the great Difficulty there is of pointing the Needle so exactly, before it is touched with the Loadstone as to take any Position indifferently: for, when it is pretty near the Truth, it is extremely troublesome to place it at rest in the Position desired, in order to try which Way it is inclined to move. It cannot be done in the open Air; for the least Motion of it will disturb the Needle, and when it is shut up, it is no easy Matter to settle it in the Place intended. And that there will be a sensible Difference of the Dip, upon shifting the Sides of the Needle, whatever Pains be taken to prevent it, I am fully satisfied from the following Experiments.

I touched both Sides of that End of the Needle, which I designed to point South, upon the North Pole of a small *Terrella*; after which I caused it to vibrate in an Arch of ten Degrees, and counted the Time by a Pendulum Clock, shewing Seconds, till the Needle had performed 50 Vibrations. March 20, 1722. Experiment I.

It performed the first 25 Vibrations in	—	—	—	—	1 2	11 58
The next 25 Vibrations in	—	—	—	—	2	27
					5 25	
The 50 in					5	25
Which gives for each Vibration at a Medium					—	6, 5
The Needle dipped					—	73° 15'

Then I shifted the Needle so that the Side, which before respected the East, was now turned West, and causing it to vibrate in the same Arch, as before, it performed Experiment II

The first 25 Vibrations in	—	—	—	—	1 2	11 49
The next 25 in	—	—	—	—	2	39
					5 28	
The 50 Vibrations in					5	28
That is, each Vibration in					—	6, 56
The Dip					—	73° 50'

I now touched the same End of the Needle, a second Time, on both Sides, upon the same Stone, and suffering it to vibrate as before, Experim. III.

It performed 25 Vibrations in	—	—	—	—	1 2	11 49
That is, one Vibration in	—	—	—	—	—	6, 76
The Dip					—	73° 20'

The Needle was now shifted, and stood as in the second Experiment. Experim. IV.



It performed 25 Vibrations in —————  $\frac{1}{2}$   $\frac{11}{41}$   
 That is, one Vibration in —————  $\frac{11}{6, 44}$   
 Dip —————  $73^{\circ} 45'$

*Experim. V.* The same End of the Needle being now touched twice on each Side, with the Loadstone presented by the Lord *Paisley* to the Royal Society, in the Armour,

It performed the first 25 Vibrations in —————  $\frac{1}{1}$   $\frac{11}{58}$   
 The next 25 in —————  $\frac{1}{1}$   $\frac{11}{46}$   
 The 50 Vibrations in —————  $\frac{3}{44}$   
 That is, each Vibration in —————  $\frac{11}{4, 48}$   
 The Dip —————  $73^{\circ} 55'$

*Experim. VI.* The Needle being turned, and standing as in the second and fourth Experiments, it performed

The first 25 Vibrations in —————  $\frac{1}{2}$   $\frac{11}{00}$   
 The next 25 in —————  $\frac{1}{1}$   $\frac{11}{57}$   
 The 50 Vibrations in —————  $\frac{3}{57}$   
 That is, each Vibration in —————  $\frac{11}{4, 74}$   
 The Dip —————  $74^{\circ} 10'$

*Experim. VII.* I now touched the Needle at both Ends with the same Stone, with which it was touched in the fifth Experiment, after which it performed

The first 25 Vibrations in —————  $\frac{1}{1}$   $\frac{11}{35}$   
 The next 25 in —————  $\frac{1}{1}$   $\frac{11}{34}$   
 The 50 in —————  $\frac{3}{9}$   
 That is, each Vibration in —————  $\frac{11}{3, 78}$   
 The Dip —————  $74^{\circ} 20'$   
 The Dip repeated with the Needle taken off }  $74^{\circ} 20'$   
 and replaced

*Experim. VIII.* Upon shifting the Needle, it performed

The first 25 Vibrations in —————  $\frac{1}{1}$   $\frac{11}{33}$   
 The next 25 in —————  $\frac{1}{1}$   $\frac{11}{34}$   
 The 50 in —————  $\frac{3}{7}$   
 The Dip —————  $74^{\circ} 25'$   
 The Dip repeated —————  $74^{\circ} 03'$  N.B. The



N B. The Needle had the same Side to the East in the first, third, fifth, and seventh Experiments; and had that Side turned Westward in the second, fourth, sixth, and eighth; and I began to count the Vibrations, when I observed it to vibrate just 10 Degrees, as near as I could guess. All these Experiments were made with sufficient Care in every Particular excepting the Quantity of the Dip, which requires the Divisions of the Semicircle to be very equal, and the 90th Degree to be perpendicular under the Axis of the Needle; this last I found was a little faulty, the Dip being in Reality greater than the Semicircle shewed it. After I had rectified this Error, and new touched the Needle, upon that Part of the Armour to which Iron is applied, when it is to be lifted by the Stone, it performed the same Number of Vibrations in less Time than in any of the former Trials. I now determined to observe, for some Space of Time, both the Dip and Vibrations, without fresh touching the Needle. The Observations follow, by which it appears there is a very considerable Difference, both in the Quantity of the Dip, and in the Quickness of the Vibrations.

N B. In all these Experiments, the Needle was placed, so as to vibrate exactly in the Plane of the Magnetic Meridian; and sufficiently distant from all Iron that could affect it, as far as I could perceive, till I had Occasion to put up a very large Iron Rod in the Room above it, which immediately altered the Dip of the Needle, and thereby put an End to these Trials.

1723.	Dip	Time of the Day.
	o    '    h    '	
Mar. 29.	75=00 at	10=00.
	74=53	4=15
30.	74=55+	1=00
	74=50—	4=00
31.	74=50—	10=00
	74=50—	12=30
	74=50—	2=15
April 1.	74=25	6=45
	74=25—	7=15
	74=20+	9=00
2.	74=20+	7=30.A.M.
	74=20+	7=30.P.M.
3.	74=20+	9=30
	74=20+	12=30
	74=50	4=15

	Dip	Time of the Day.
	o    '    h    '	
Apr 4.	74=55+	10=00
	74=50+	11=15
	74=40	12=45
	74=35	7=30
5.	74=40	9=15
	74=40	1=45
	74=40+	5=30
	74=30+	8=15
6.	74=35	10=00
	74=35	12=00
7.	74=35+	10=20
	74=35+	12=30
	74=35	4=00
	74=35	6=30
8.	74=40—	12=15
	74=40—	3=30



## Observations of the Dipping-Needle.

Dip		Time of the Day.	
	o    /	h    /	
April 9.	74=40—	10=00	
	74=40—	4=15	
10	74=40—	10=00	
	74=30+	8=00	
11.	74=35+	10=00.A.M.	
13.	74=40—		
14.	74=40—	10=45	
	74=40—	11=15	
	74=35	5=10	
	74=35	8=17	
15.	74=35	9=10.A.M.	
16.	74=35	11=00	
	74=30+	8=45	
17.	74=45	12=25	
18.	74=40+	9=15	
	74=45	5=00	
19.	74=45	9=00.A.M.	
20.	74=45		
21.	74=50	10=30	

Dip		Time of the Day	
	o    /	h    /	
April 23.	74=50	12=00	
	74=50+	2=30	
26.	74=50+	2=30	
27.	74=55		
28.	75=00	1=00. P.M.	
	75=00.	3=15	
	74=58	5=15	
30.	74=40	3=15	
	74=45	1=30	
May 1.	74=45	12=00	
	74=45+	1=00	
	74=40+	3=50	
	The Weight of the dipping Needle 9pt. 21gr. Troy.		
N. B. The Mark + signifies something more than is here set down, and — signifies something less, but the Difference could scarce amount to more than two Minutes.			

Experiments of the Vibrations of the Dipping-Needle, beginning with an Arch of 10 Degrees, with the Times in which 100 Vibrations were performed:

172 h /  
 April 1. about 7=15 Afternoon.  
 First 50 in 3=2  
 Last 50 in 2=45  
 The 100 in 5=47. Dip 74°=25—  
 April 2. in the Evening  
 First 50 in 3=3  
 Last 50 in 2=43  
 The 100 in 5=46. Dip 74=20+

l. ll.  
 April 3. about 4 in the Afternoon.  
 First 50 in 2=52  
 Last 50 in 2=39  
 The 100 in 5=31. Dip 74=50  
 Repeated about an Hour after.  
 First 50 in 2=53  
 Last 50 in 2=35  
 The 100 in 5=28. Dip 74=50+



1723  
April 4. about 11<sup>h</sup> 15 in the Morn.

First 50 in 2<sup>11</sup>=54  
Last 50 in 2=30

The 100 in 5=24. Dip 74=50+

April 28. about 5=15 Afternoon.

First 50 in 2=48  
Last 50 in 2=16

The 100 in 5= 4. Dip 74=58  
Repeated

First 50 in 2=47  
Last 50 in 2=16

The 100 in 5= 3. Dip 74=58

May 20. 1<sup>11</sup>

First 50 in 3=11  
Last 50 in 3= 1

The 100 in 6=12

Repeated the Needle being new touched.

First 50 in 2=38  
Last 50 in 2=23

The 100 in 5= 1. Dip 74=35

Repeated again about an Hour after.

First 50 in 2<sup>11</sup>=38  
Last 50 in 2=20

The 100 in 4=58. Dip 74=30+

May 21. about Noon.

First 50 in 2=41  
Last 50 in 2=28

The 100 in 5= 9. Dip 74=30

May 23. about 12h=45'

First 50 in 2=40  
Last 50 in 2=27

The 100 in 5= 7. Dip 74=40

May 25. about 3=30

First 50 in 2=41  
Last 50 in 2=30

The 100 in 5=11. Dip 74=40+

May 27. about 6=30 Afternoon.

First 50 in 2=41  
Last 50 in 2=28

The 100 in 5= 9. Dip 74=50

VI. 1. Wednesday, June the first 1720, being at Anchor near Revel, in the Latitude of 58° 58' North, the Magnetical Amplitude at Sun-set was

West ————— 64° 30' North.  
And the true was West ————— 49 37 North

Variation North ————— 14 53 West.

Saturday July 23, at the Isle Gottsand in the Latitude of 58° 21' North, at Sun-set, the Magnetical Amplitude was West ————— 49° 50' North, and the

true Amplitude, West ————— 35 00 North, which

gives the Variation North ————— 14 50 West.

The Difference of Longitudes of the two aforesaid Places by Dead Reck. is 1° 50'.

October 24 at Bornholme, in the Latitude of 56° 00', at Sun-rising, the Magnetical Amplitude was

Magnetical  
Variations, in  
the Baltick,  
by Mr Wil-  
liam Sander-  
son, No.  
366. pag.



# The Variation of the Magnetical Compass.

East  $43^{\circ} 15'$  South, and the true was  
 East  $28 \quad 31$  which gives the Variation

North  $14 \quad 44$  West.

*The Variation of the Magnetical Compass, observed by Capt. Rogers, Commander of the Ship Duke, in his Passage from Cape St Lucar in California to the Isle of Guam or Guana, one of the Ladrones, with some Remarks thereon. Communicated by Dr Halley, N<sup>o</sup>. 368. p. 173.*

2. Having lately had the Opportunity of perusing Capt. Woods Rogers's original Journal, who in  $17^{\frac{29}{10}}$ , in eight Weeks time traversed the great *South-Sea*, or *Pacific Ocean*, I was highly pleased to find the Care he had taken to set down the Variations of the *Magnetical Compass* in his Passage from the South Cape of *California* to the Island of *Guana*, being about seven Hours or 105 Degrees of Longitude. This might have been long since expected from Capt. *Dampier*, who had three times made the *Tour* of the *World*, and thrice gone this very same Track.

It were to be wished that the *French*, who have had frequent Opportunities to do it, would bestow upon us an Account of the Variations they have lately found in their Voyages from *Peru* and *Chili* to *China*; and that the *Spaniards* would tell us how the Needle varies at this time in the North Part of that great Sea, through which they return from the *Manilla's* to *New Spain*. With these helps, having three Points in each Curve, we might be enabled with a tolerable certainty to complete the System of the Magnetic Variations, which I was forced to leave unfinished, as to this part of the Ocean, in my General Chart thereof, for want of the Observations requisite.

In the mean time, please to take the following Account extracted from Capt. Rogers's Journal; wherein the first Column gives the correct Latitude of the Place; the second, the Longitude West from *London*, as estimated by Reckoning; and the third the Variation, which in this whole Track is *Easterly*.

*Variations observed in the Great South-Sea, from the South Cape of California to the Island of Guana or Guam, one of the Ladrones.*

January $17^{\frac{29}{10}}$	Lat. N. correct. every Day.		Long. West. from London.		Variation Easterly.	
12	22	16	114	09	03	00
	21	18	114	42	02	50
	20	24	115	15	02	50
15	19	25	115	45	02	50
	18	56	116	24	02	45
	18	00	117	06	02	45
	17	11	117	30	02	15
	16	32	118	05	02	00
20	15	44	118	54	01	50
	15	00	120	15	01	30



*Variations observed in the SOUTH-SEA.*

1709-10. January	Lat. N. correct. daily	Long. West from London.	Variation Easterly.
22	14 49	122 05	01 10
	14 36	124 25	00 50
	14 24	126 45	00 40
25	14 14	129 05	00 45
	13 50	131 23	00 50
	13 29	132 58	01 00
	13 29	134 41	01 10
	13 22	136 48	01 15
30	13 27	139 21	01 25
	13 32	142 07	01 30
Feb. 1	13 32	144 37	01 40
	13 36	147 32	01 50
	13 26	150 18	02 00
5	13 26	153 02	02 10
	13 26	155 19	02 25
	13 26	157 43	02 30
	13 25	160 31	02 50
	13 41	163 00	03 00
	13 41	165 18	03 20
10	13 44	167 26	03 30
	13 36	169 56	03 45
	13 33	172 27	04 00
	13 36	175 00	04 30
	13 32	177 21	05 20
15	13 40	179 28	06 30
	13 47	181 24	07 00
	13 54	183 22	07 30
	13 52	185 37	09 00
	13 40	187 42	10 15
20	13 28	189 49	11 00
	13 21	191 30	11 30
	13 12	193 25	12 00
	13 07	194 37	11 50
	13 10	195 51	11 00
25	13 03	197 51	10 00
	13 00	199 03	09 50
	12 57	200 16	09 30
	12 54	202 20	09 00
March 1	12 58	204 12	08 40
	13 04	206 06	08 20



# Variations of the Magnetical Compass.

Variations observed in the SOUTH-SEA.

1709-10.	Lat. N. correct. daily	Long. West from London.	Variation Easterly.
March 3	13 05	207 33	08 00
	13 05	209 04	07 50
5	13 02	211 54	07 30
	13 07	212 42	07 10
	13 07	214 07	07 00
	13 03	215 28	06 50
	13 08	217 11	06 30
10	13 16	218 27	05 40
Island of Guana in Sight.			

By this it appears, that at about 250 or 300 Leagues West from the South-head of *California*, the *East Variation* diminishes to about  $\frac{3}{4}$  of a Degree ; That for 1300 Leagues from thence, the same *Easterly Variation* gradually increases to about 12 Degrees, where it becomes greatest. And that at the Isle of *Guam*, five hundred Leagues still more *Westerly*, it is again decreased to 5 Degrees 40 Minutes.

As far as this single Instance can direct us, I am inclinable to think that in all that space of Sea which lies to the Northwards of our Track, between *Japon* and *California*, there reigns an *Easterly Variation*, which is still greater and greater as the North Latitude increases. But that to the Southward of our Track, and especially to the Southward of the Equinoctial, a *Westerly Variation* arises, of no great extent or quantity, but which is greatest about 1000 Leagues West from the Coasts of *Peru* and *Chili*, about the same Meridians where Capt. *Rogers* found the *East Variation* smallest. This is agreeable to the *Theory* of the *Variation* I laid down in N<sup>o</sup>. 148. of these *Transactions*, about 40 Years since ; and I then expressly mentioned, in my seventh Remark on the Observations there cited, that there was undoubtedly such a Tract of *West Variation* in the Southern Parts of the *South-Sea*, it being the necessary Consequence of the Site of the four Magnetical Poles there supposed, though at that time I wanted Experiments to prove it.



3. Observations of the Variation on board the *Royal African* *Pacquet*, in 1721. By Capt. Cornwall.  
 N. B. The Meridional Distance is reckoned from St Jago.

Observations  
 of the Varia-  
 tion on board  
 the *Royal*  
*African Pac-*  
*quet*, in 1721.  
 By Capt  
 Cornwall.  
 N°. 371. p.  
 55.

Month and Year.	Latitudes.			Meridional Distance.			Longitud.			Variation.		
August 24th 1721	9°	8'	Sou.	9°	23'	W	9°	25'	W	2°	13'	E
Ditto 26	11	12	S	10	46	W	10	50	W	4	30	E
Ditto 27	11	34	S	11	28	W	11	41	W	4	29	E
Ditto 28	12	32	S	11	31	W	11	43	W	4	27	E
Ditto 31	15	46	S	10	53	W	11	6	W	6	10	E
Septemb. 2d.	16	26	S	8	25	W	8	30	W	7	16	E
Ditto 5th	18	45	S	9	31	W	9	39	W	6	17	E
Ditto 6th	19	47	S	9	10	W	10	0	W	8	6	E
Ditto 17	28	43	S	1	7	W	1	9	E	5	53	E
Ditto 22	31	33	S	3	41	E	3	56	E	4	10	E
Ditto 27	33	30	S	11	29	E	12	57	E	0	11	W
Ditto 30	32	40	S	19	6	E	12	1	E	3	0	W
October 1st,	32	53	S	21	18	E	24	59	E	5	41	W
Ditto 3	32	30	S	25	33	E	30	0	E	7	47	W
Ditto 5	32	28	S	30	37	E	35	52	E	8	44	W
Ditto 6	31	22	S	31	40	E	37	7	E	10	57	W
Ditto 7	31	11	S	32	4	E	37	47	E	11	20	W

Observations on the Coast of Africa.

Month and Year	Latitudes.			Meridional Distance.			Longitud.			Variation.		
October 13 <sup>th</sup> , 1721.	26°	17'	S	35°	35'	E	41°	41'	E	14°	30'	W
Ditto 19	19	41	S							12	22	W
Ditto 21	17	4	S							14	29	W
Ditto 25	13	56	S							14	48	W
Novem. 4 <sup>th</sup> ,	10	57	S							13	11	W
Ditto 7	8	19	S							15	14	W
Ditto 29	5	0	S	in Cabenda-Bay						14	33	W

From Cabenda to London, Meridional Distance from thence.												
Decemb. 9 <sup>th</sup> ,	3	25	S	11	38	W	11	43	W	11	32	W
Ditto 14	3	30	S	21	18	W	21	24	W			
Ditto 20	0	30	S	30	41	W	30	46	W	1	5	W
Jan. 1 <sup>st</sup>	10	50	N	39	8	W	39	16	W	1	1	E
172 ½												
Ditto 6	17	15	N	43	21	W	43	29	W	1	41	E



*Variation of  
the Horizontal  
Needle at  
London, in  
the latter  
Part of the  
Year 1722,  
and beginning  
of 1723. By  
Mr George  
Graham,  
Watchmaker,  
F. R. S. No.  
383. p. 96.*

4 The Figure of the three Needles, with which the Experiments were made, was prismatic; their Lengths were nearly 12,2 Inches; their Ends, which pointed to the Divisions, being filed to an Edge, which made a fine Line perpendicular to the Horizon. The Caps of two were of Crystal, the other of Glass; they were well polished on the Inside, in that Part which touched the Pin they moved upon. The Box was Brass, and of a Breadth sufficient to admit of  $20^{\circ}$  on each Side the middle Line, and covered with a piece of ground Glass. The circular Arches at the Ends were raised so much above the Bottom of the Box, as to have their upper Surfaces, upon which the Divisions were cut, lie in the same Plane with the Needle, and at such a Distance from each other, that the Needle might play freely between them. A few of the Degrees at the North End were divided into six equal Parts, each Division being  $10'$ . It was easy, by the help of a Convex Glass, to determine the pointing of the Needle to less than a Quarter of these Divisions, or to about  $2'$  of a Degree. The Pin, upon which the Needle moved, was of Steel hardened, and ground to a fine Point; and by a Spring placed in the Box, the Needle might be raised from off the Point, and let down again at Pleasure, without removing the Glass, or disturbing the Box. By this means both the sharpness of the Point, and polish of the Cap were better preserved from injury, when there was occasion to move the Box. A small piece of Brass was made to slide upon that End of the Needle which pointed to the South, for readily bringing it to an horizontal Position; for according to the different strength of the Touch, the North End of the Needle will dip more or less. The bottom Plate of Brass was a little broader and longer than the Box and it's Edges made Lines exactly parallel to the middle Line of the Divisions; and for the greater security of placing the Box in a right Situation, there was a Brass Ruler of thirty Inches long, having it's Edges even and parallel, except part of that Edge which was applied to the Side of the Box which was a little filed away on the middle, that the Side of the Box near it's Ends only might touch the Ruler. By this Contrivance the two Points of Contact were as far asunder as the length of the Box would admit of, and the other Edge of the Ruler making a longer Line than the Side of the Box, afforded a better Direction for giving it the same Situation.

For determining the Quantity of the Variation, I got a Meridian Line stretched upon the top of the House, between the Rails of the Leads, which were above fifteen Foot asunder, and the Line was a little more than thirty-nine Inches above the Leads. As this Line was fastned to two Pieces of Brass that were fixed in the Rails, and was above fifteen Foot long, no sensible Error could arise in putting it up at any Time. The Compass-Box was placed upon a Wooden Stool, with three Feet, that had nothing of Iron about it, and it's Top set level by a Plumb-Rule. But finding that in the open



open Air the Wind gave some Disturbance, I put up another Line, after the same manner, in a Room two pair of Stairs high; this Line was about the same length with the other, and thirty-nine Inches above the Floor. Some time after I put up a third Line, of the same Length, in the Room over this. By the Method made use of in fixing these Lines they could not differ above  $2'$  of a Degree from the Meridian, or from one another. Before I had made any Trials, I imagined no other Difference would arise than what might be occasioned by the Friction of the Needle upon the Point it was to move upon, and having found that considerable in all the Needles that I had taken notice of, I took more than ordinary Care to provide against it, and succeeded beyond my Expectation. For I have several times observed all the three Needles return so exactly to the same Place, that I could not perceive the least Difference; as likewise all three to agree very nearly about the same Time, when they have been placed in the same Box immediately one after another, the Box remaining unmoved. The first Needle I made, was a little above three tenths of an Inch broad, about  $,06$  in thickness, and weighed about an Ounce Troy, the Cap of Crystal. After some Trials with this Needle, it was made narrower, not to exceed half a tenth of an Inch, and it then weighed five Penny Weight and five Grains. The second Needle was at first about three tenths of an Inch broad, and  $,04$  thick, the Cap of Glass; and after several Trials, it was made so much narrower, that it's Breadth was a little less than it's Thickness, and it weighed two Penny Weight and five Grains. The third was nearly of the same Dimensions with the second, and weighed two Penny Weight and three Grains. When the two first Needles were made narrower care was taken that the Files made use of for filing the North Ends, touched not the South Ends; and after they were made lighter, I tried them both, before they were fresh touched upon the Stone, and found no sensible Difference in their Direction. The reason of making the two first Needles so heavy, was to try whether, they would return more constantly to the same Situation than lighter ones. But notwithstanding each of them would settle very exactly in the same Place, for a great Number of Trials made immediately one after another, yet I found them at different Times to differ considerably from their former Directions.

This occasioned my making them narrower, fearing their Breadth had been some way concerned in this Irregularity. But after the Alteration, I found the same thing happened, though I could find nothing of it to proceed from any Friction upon the Point. This made me prefer the lighter Needles, as less apt to injure the Point they moved upon, and as exact in returning to the same Situation. After many Trials, I found all the Needles I made use of, would not only vary in their Direction upon different Days, but frequently at different times of the same Day; and this Difference would some-



times amount to upwards of half a Degree in the same Day, sometimes in a few Hours. And this Alteration I observed, whether the Needles were drawn aside immediately before the Observation, or suffered to remain undisturbed. For I have left the Box standing for several Days together, without ever disturbing the Needle, only have taken notice what it pointed at, and the Time of the Day, and I could sometimes perceive in a few Minutes a very sensible Alteration. But whether it stood near it's greatest or least Variation, or whether I drew the Needle to one Side with a Key a few Degrees or a greater Number, it would constantly return to the same Place it stood at immediately before. Sometimes I have taken the Needle out of the Box, and put it in again, and this I have repeated several times in the space of an Hour. At other times I have taken down the Box from off the Stool, and put it up again, but have found no Alteration in it's Direction; so that I found it of no Consequence, whether the Needle was drawn aside or let alone, the shaking of the Floor by walking upon it, or the trembling of the House by the Coaches in the Street, was sufficient to overcome the small Friction upon the Point. When I made the Observations, I was very careful to have no Keys, nor Iron about me, that could affect the Needle.

The Box was placed in the Room above the Distance of six Foot from the nearest Wall, and above thirteen Foot from the Grate in the Chimney, and no Iron could at any time be brought near it without my Knowledge. Yet, after all, I am not satisfied that it was out of the reach of Iron, and that the Variation shewn by it is the true Quantity; but I am very sure there was no Change of Circumstances in the Room that could affect it, for if there were any such Materials in the Wall, or Floor, their Distances and Situations continued the same. But for a farther Confirmation of this Irregularity, I put one of the Needles into a Wooden Box, with a few Degrees divided as the other, and placed it at the same Meridian Line, at the Distance of three Foot and a half from the other, and found both Needles nearly agreed in their Alterations. The Needles were all touched by that excellent Load-stone presented to the Society by the Lord *Paisley*. It may not be improper to take Notice, that the Needles were not touched upon the naked Stone, but with it's Armour on, generally upon that Part of the Capping nearest the Poles; but I could not find a Difference in the Direction, by touching upon another Part. I may add, that when I have observed the Needle increasing, or decreasing in it's Variation, I have very frequently, with a Key, drawn it the contrary Way several Degrees, and then, letting it return very gently, till it has been within a Degree, or less, of the Place it stood at immediately before, I have there stopt it for some time, by holding the Key at a proper Distance; and withdrawing my Hand gradually, have tried



to make it stand short of it's former Place, but could never succeed. By this Method, and several others made use of, I am well assured these Changes in the Direction are owing to some other Cause than the Friction of the Needle upon the Pin; but what that Cause is I cannot say, for it seems to depend neither upon Heat nor Cold, a dry or moist Air, clear or cloudy, windy or calm Weather, nor the Height of the Barometer. The only thing that has any appearance of Regularity, is, that the Variation has been generally greatest, for the same Day, between the Hours of Twelve and Four in the Afternoon, and the least about six or seven in the Evening.

*March 8. 1722.*

This Day a piece of Brass was fixed to a Wooden Box, and a few Degrees were divided into 10' each, as in the Brass Box, to try if both Needles would be alike affected in the several Alterations. This Wooden Box was placed at the same Meridian Line, and about the Distance of 3  $\frac{1}{2}$  Feet from the other.

Brass Box. Needle 2=5.		Needle 5=5
	h.	
<i>March 8.</i> 14° = 30' —	3 = 00'	14° = 25' +
14 = 20	3 = 15	14 = 20
14 = 15 +	4 = 00	14 = 10
14 = 20	4 = 15	14 = 15
14 = 25	5 = 00	14 = 20
14 = 25	5 = 30	14 = 20
14 = 15	5 = 45	14 = 10
14 = 00	5 = 57	14 —
14 —	6 = 8	13 = 55
13 = 50	6 = 15	13 = 40
14 = 20	6 = 38	14 = 15 +
14 +	6 = 48	14 = 00
14 = 00	6 = 54	14 —
14 = 5	7 = 5	14 +
14 = 10	7 = 15	14 = 5
14 +	12 = 00	14 +



## Variation of the Horizontal Needle at London.

Brafs Box.	Needle 2=5.		Needle 5=5.
<i>March 9.</i>	14° = 10'	9 <sup>h</sup> = 30'	14° = 10'
	14 = 10 +	10 = 00	14 = 10 +
	14 = 10	10 = 15	14 = 10
	14 = 10 +	10 = 30	14 = 10 +
	14 = 15	11 = 00	14 = 15 —
	14 = 00	8 = 15	14 = 00
	14 = 00	11 = 50	14 = 00

<i>March 10.</i>	14° = 10' +	10 <sup>h</sup> = 00'	14° = 10'
	14 = 15	11 = 00	14 = 10 +
	14 = 15	12 = 00	14 = 10 +
	14 = 15 +	12 = 45	14 = 10 +
	14 = 15 +	1 = 00	14 = 10 +
	14 = 15 +	1 = 30	14 = 10 +
	14 = 15 +	1 = 45	14 = 10 +
	14 = 15 +	2 = 00	14 = 10 +
	14 = 15	3 = 30	14 = 10
	14 = 15 +	4 = 00	14 = 10 +
	14 = 15 —	5 = 30	14 = 10 —
	14 = 10	6 = 00	14 = 5
	14 = 00	6 = 15	14 = 00
	14 —	6 = 30	14 —
	14 +	7 = 30	14 +
	14 = 5	7 = 45	14 +
	14 +	12 = 00	14 +

*March 30.*

The Needle 2=5 which was in the Brafs Box, was this Day put into the Wooden Box, and a new Needle put into the Brafs Box, Weight 2=3.

No remarkable Change happened to either Needle till *April* the 5th.



Needle 2=3 in the Brass Box.

April 5.

14° = 5'  
14 = 10  
14 = 10 —  
14 —  
13 = 50 +  
13 = 55 +  
14 —  
14 = 00  
14 +

9<sup>h</sup> = 00'  
1 = 30  
5 = 30  
8 = 15  
8 = 37  
9 = 45  
10 = 25  
10 = 45  
11 = 00

Needle  
2=5.

14° + 00'  
14 = 5  
14 +  
14 —  
13 = 45  
13 = 45 +  
13 = 50  
13 = 55  
14 = 00

The first Column shews the Variation of the Needle in the Brass Box. The third the Variation of that in the Wooden Box. The second Column shews the Time, by the Clock, when the Observations were made.

April 15. 1723.

14° = 30' — 9<sup>h</sup> = 00'  
14 = 30 — 10 = 00  
14 = 30 — 11 = 30  
14 = 30 + 12 = 30  
14 = 30 + 1 = 30  
14 = 30 3 = 30  
14 = 30 4 = 10  
14 = 30 — 5 = 30  
14 = 20 6 = 18  
14 + 7 = 8  
14 = 00 7 = 50  
14 = 00 8 = 15  
14 = 15 + 8 = 20  
14 = 15 + 8 = 40  
14 = 15 + 12 = 15  
14 = 00 12 = 27  
14 = 00 12 = 32  
14 = 00 12 = 35  
14 = 00 12 = 43

Wind at S. W.

April 16.

14° = 30' — 9<sup>h</sup> = 30'  
14 = 30 11 = 00  
14 = 30 12 = 00  
14 = 30 + 1 = 10  
14 = 30 + 1 = 40  
14 = 30 2 = 45  
14 = 30 5 = 00  
14 = 30 — 6 = 00  
14 = 25 6 = 20  
14 = 20 6 = 30  
14 = 15 6 = 35  
14 = 10 6 = 40  
14 = 10 — 6 = 45  
14 = 5 6 = 49  
14 = 00 6 = 57  
14 = 00 7 = 10  
14 + 7 = 20  
14 = 05 + 7 = 30  
14 = 10 7 = 45  
14 = 15 8 = 00

14 =



## Variation of the Horizontal Needle at London.

$14^{\circ} = 15' +$	$8^h = 20'$
$14 = 20 -$	$8 = 30$
$14 = 25 +$	$9 = 00$
$14 = 25$	$12 = 12$
$14 = 25$	$12 = 21$

Day warm, cloudy in the  
Morning, Evening clear.

April 19.

$14^{\circ} = 30' -$	$8^h = 35'$
$14 = 30 -$	$9 = 00$
$14 = 30 -$	$1 = 30$
$14 = 30 -$	$2 = 00$
$14 = 30$	$3 = 30$
$14 = 30$	$4 = 00$
$14 = 20$	$5 = 00$
$14 = 25$	$5 = 38$
$14 = 25 +$	$5 = 45$
$14 = 30 -$	$6 = 00$
$14 = 30 -$	$6 = 45$
$14 = 25$	$7 = 00$
$14 = 20 -$	$8 = 00$
$14 = 20$	$9 = 00$
$14 = 20 +$	$10 = 00$
$14 = 25$	$11 = 00$
$14 = 25$	$11 = 15$

Day warm, Wind at East,  
some Thunder in the  
Afternoon.

May 2.

$14^{\circ} = 25'$	$9^h = 30'$
$14 = 30 +$	$10 = 30$
$14 = 35 -$	$11 = 30$
$14 = 35 +$	$1 = 00$

$14^{\circ} = 35' +$	$1^h = 52$
$14 = 40 +$	$2 = 30$
$14 = 20$	$3 = 30$
$14 = 25$	$3 = 45$
$14 = 30 -$	$4 = 00$
$14 = 25 +$	$6 = 45$
$14 = 20$	$7 = 00$
$14 = 30 -$	$7 = 35$
$14 = 20 +$	$12 = 50$

Day cold, Wind at East.

May 3.

$14^{\circ} = 10'$	$9^h = 30'$
$14 = 15$	$11 = 10$
$14 = 15 +$	$12 = 40$
$14 = 15 +$	$2 = 20$
$14 = 10 -$	$5 = 20$
$14 = 10$	$6 = 5$
$14 = 10$	$6 = 45$
$14 = 10 -$	$7 = 5$
$14 = 5$	$7 = 15$
$14 +$	$7 = 30$
$14 = 00$	$7 = 42$
$14 +$	$8 = 00$
$14 +$	$9 = 38$
$14 +$	$10 = 15$
$14 +$	$11 = 00$

Day cold, Wind Easterly.

May 4.

$14^{\circ} = 5'$	$9^h = 15'$
$14 = 5$	$9 = 30$
$14 = 10 +$	$1 = 35$
$14 = 10 +$	$3 = 17$
$14 = 10 +$	$3 = 50$



14° = 10'	4h = 55'	14° = 15 +	12h = 30'
14 = 10	6 = 00	14 = 20	1 = 57
14 = 00	8 = 15	14 = 20	2 = 45
14 +	1 = 00	14 = 20	3 = 25
Windy at East.		14 = 20 —	4 = 35
		14 = 15 +	5 = 30
		14 = 15 +	6 = 10
		14 = 15 —	12 = 7
May 5.		Day clear, Wind at East.	
14° = 10' +	9h = 30'		
14 = 15	10 = 45		

All these Observations are of the lightest of the three Needles, the Compass Box remaining unmoved the whole time. From February 6. 1722. to the 10th of May following, I made above a thousand Observations in the same Place; and the greatest Variation Westward, was 14°=45', and the least — — 13°=50'. It was seldom less than 14°, or greater than 14°=35'.

5. A New and Exact TABLE, collected from several Observations, taken in four Voyages to Hudson's Bay in North America, from London: Shewing the Variation of the Magnetical Needle, or Sea Compass, in the Path-way to the said Bay, according to the several Latitudes and Longitudes, from the Year 1721, to 1725.

Lat.		Long.		Vari.		Lat.		Long.		Vari.	
D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
50	00	12	00	14	00	50	00	18	45	17	00
51	00	12	00	14	15	51	00	18	45	17	15
52	00	12	00	14	30	52	00	18	45	17	30
53	00	12	00	14	45	53	00	18	45	17	45
54	00	12	00	15	00	54	00	18	45	18	00
55	00	12	00	15	15	55	00	18	45	18	15
56	00	12	00	15	30	56	00	18	45	18	30
57	00	12	00	15	45	57	00	18	45	18	45
58	00	12	00	16	00	58	00	18	45	19	00
59	00	12	00	16	15	59	00	18	45	19	15
50	00	14	15	15	00	50	00	21	00	18	00
51	00	14	15	15	15	51	00	21	00	18	15
52	00	14	15	15	30	52	00	21	00	18	30
53	00	14	15	15	45	53	00	21	00	18	45
54	00	14	15	16	00	54	00	21	00	19	00
55	00	14	15	16	15	55	00	21	00	19	15
56	00	14	15	16	30	56	00	21	00	19	30
57	00	14	15	16	45	57	00	21	00	19	45
58	00	14	15	17	00	58	00	21	00	20	00
59	00	14	15	17	15	59	00	21	00	20	15

collected from several Observations, taken in four Voyages to Hudson's Bay in North America, from London, By Capt. Christopher Middleton, No. 393. pag. 73.



*Variation of the Compass.*

Lat.		Long.		Vari.		Lat.		Long.		Vari.	
D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
50	00	16	30	16	00	50	00	23	15	19	00
51	00	16	30	16	15	51	00	23	15	19	15
52	00	16	30	16	30	52	00	23	15	19	30
53	00	16	30	16	45	53	00	23	15	19	45
54	00	16	30	17	05	54	00	23	15	20	00
55	00	16	30	17	10	55	00	23	15	20	15
56	00	16	30	17	30	56	00	23	15	20	30
57	00	16	30	17	45	57	00	23	15	20	45
58	00	16	30	18	00	58	00	23	15	21	00
59	00	16	30	18	15	59	00	23	15	21	15
50	00	25	30	20	00	50	00	34	30	24	00
51	00	25	30	20	15	51	00	34	30	24	15
52	00	25	30	20	30	52	00	34	30	24	30
53	00	25	30	20	45	53	00	34	30	24	45
54	00	25	30	21	00	54	00	34	30	25	00
55	00	25	30	21	15	55	00	34	30	25	15
56	00	25	30	21	30	56	00	34	30	25	30
57	00	25	30	21	45	57	00	34	30	25	45
58	00	25	30	22	00	58	00	34	30	26	00
59	00	25	30	22	15	59	00	34	30	26	15
50	00	27	45	21	00	50	00	36	45	25	00
51	00	27	45	21	15	51	00	36	45	25	15
52	00	27	45	21	30	52	00	36	45	25	30
53	00	27	45	21	45	53	00	36	45	25	45
54	00	27	45	22	00	54	00	36	45	26	00
55	00	27	45	22	15	55	00	36	45	26	15
56	00	27	45	22	30	56	00	36	45	26	30
57	00	27	45	22	45	57	00	36	45	26	45
58	00	27	45	23	00	58	00	36	45	27	00
59	00	27	45	23	15	59	00	36	45	27	15
50	00	30	00	22	00	50	00	39	00	26	00
51	00	30	00	22	15	51	00	39	00	26	15
52	00	30	00	22	30	52	00	39	00	26	30
53	00	30	00	22	45	53	00	39	00	26	45
54	00	30	00	23	00	54	00	39	00	27	00
55	00	30	00	23	15	55	00	39	00	27	15
56	00	30	00	23	30	56	00	39	00	27	30
57	00	30	00	23	45	57	00	39	00	27	45
58	00	30	00	24	00	58	00	39	00	28	00
59	00	30	00	24	15	59	00	39	00	28	15
50	00	32	15	23	00	50	00	41	15	27	00
51	00	32	15	23	15	51	00	41	15	27	15
52	00	32	15	23	30	52	00	41	15	27	30
53	00	32	15	23	45	53	00	41	15	27	45
54	00	32	15	24	00	54	00	41	15	28	00
55	00	32	15	24	15	56	00	41	15	28	15
56	00	32	15	24	30	57	00	41	15	28	30
57	00	32	15	24	45	58	00	41	15	28	45
58	00	32	15	25	00	59	00	41	15	29	00
59	00	32	15	25	15						



Lat.		Long.		Vari.		Lat.		Long.		Vari.	
D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
50	00	43	30	28	00	54	00	57	00	33	00
51	00	43	30	28	15	55	00	57	00	33	15
52	00	43	30	28	30	56	00	57	00	33	30
53	00	43	30	28	45	57	00	57	00	33	45
54	00	43	30	29	00	58	00	57	00	34	00
55	00	43	30	29	15	59	00	57	00	34	30
56	00	43	30	29	30	60	00	57	00	35	00
57	00	43	30	29	45	61	00	57	00	35	30
58	00	43	30	30	00						
59	00	43	30	30	15						
51	00	46	00	29	00	55	00	60	00	34	00
52	00	46	00	29	15	56	00	60	00	34	30
53	00	46	00	29	30	57	00	60	00	35	00
54	00	46	00	29	45	58	00	60	00	35	30
55	00	46	00	30	00	59	00	60	00	36	00
56	00	46	00	30	15	60	00	60	00	36	30
57	00	46	00	30	30	61	00	60	00	37	00
58	00	46	00	30	45						
59	00	46	00	31	00	57	00	63	00	35	00
52	00	48	30	30	00	58	00	63	00	35	30
53	00	48	30	30	15	59	00	63	00	36	00
54	00	48	30	30	30	60	00	63	00	36	30
55	00	48	30	30	45	61	00	63	00	37	00
56	00	48	30	31	00	62	00	63	00	37	30
57	00	48	30	31	15						
58	00	48	30	31	30	59	00	66	00	37	00
59	00	48	30	31	45	60	00	66	00	37	40
53	00	51	00	31	00	61	00	66	00	38	20
54	00	51	00	31	15	62	00	66	00	39	00
55	00	51	00	31	30	63	00	66	00	39	40
56	00	51	00	31	45						
57	00	51	00	32	00	60	00	69	00	41	00
58	00	51	00	32	15	61	00	69	00	41	40
59	00	51	00	32	30	62	00	69	00	42	20
60	00	51	00	32	45						
54	00	54	00	32	00	60	00	72	00	40	00
55	00	54	00	32	15	61	00	72	00	42	00
56	00	54	00	32	30	61	40	72	00	42	40
57	00	54	00	32	45						
58	00	54	00	33	00	62	00	78	00	43	00
59	00	54	00	33	15	63	00	78	00	44	00
60	00	54	00	33	30	63	50	78	00	46	00
61	00	54	00	33	45						



## Variation of the Compass.

Lat.		Long.		Vari.	
D.	M.	D.	M.	D.	M.
61	00	75	00	38	00
62	00	75	00	43	00
62	50	75	00	45	00
63	00	81	00	43	00
64	00	81	00	46	00
62	00	82	00	39	00
63	00	82	00	44	00
61	00	84	00	33	45
62	00	84	00	40	00
63	00	84	00	42	00
60	00	86	00	30	00
61	00	86	00	33	00
62	00	86	00	35	00
59	00	88	00	28	00
60	00	88	00	28	40
61	00	88	00	29	20
57	00	90	00	24	00
58	00	90	00	24	30
59	00	90	00	25	00
57	00	94	00	23	00
58	00	95	00	22	30
59	00	95	00	21	00

From Long 68 Degrees to 81. is in Hudson's Straits, where is the greatest Variation, and the Compass will hardly Traverse.

6. A TABLE collected from several Observations taken from the Year 1721 to 1729, in nine Voyages to Hudson's Bay in North-America, by Capt. Chr. Middleton; shewing the Variation of the Compass according to the Latitudes and Longitudes under-mentioned, accounting the Longitude from the Meridian of London.

Continued by  
the same, N<sup>o</sup>.  
418. p. 71.

Lat.		Long.		Variat.		Lat.		Long.		Variat.		
D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	
50	00	2 East		12	00	50	00	14	00	14	00	Obsf.
49	30	0	00	12	00	51	00	ditto		14		
50	00	2 West		13	00	52		ditto		15		
50	00	4	00	13	00	53		ditto		15		Ac.
50	00	6	00	13	00	54		ditto		16		Obsf.
51	00	8	00	14	00	55		ditto		16		Obsf.
51	00	14	00	14	00	56		ditto		17		Obsf.
52	00	12	00	15	00	57		ditto		17		Obsf.
53	00	12	00	ditto.		58		ditto		18		Obsf.
54	00	12	00	ditto.		59		ditto		18		Ac.
55	00	12	00	16	00							
56	00	12	00	16	00							
57	00	12	00	17	00							
58	00	12	00	17	00							
59	00	12	00	18	00							



Lat.		Long.		Variat.			Lat.		Long.		Variat.		
D.	M.	D.	M.	D.	M.		D.	M.	D.	M.	D.	M.	
50	00	16	00	15	00	Obs.	50	00	24	00	20	00	Ac.
51		ditto		15		Obs.	51		ditto		20		
52		ditto		16		Ac.	52		ditto		20		
53		ditto		16			53		ditto		21		Obs.
54		ditto		17		Obs.	54		ditto		21		
55		ditto		18		Ac.	55		ditto		21		Ac.
56		ditto		18			56		ditto		21		
57		ditto		19			57		ditto		21		Obs.
58		ditto		19		Obs.	58		ditto		22		
59							59		ditto		22		
50	00	18	00	17	00	Obs.	50	00	26	00	21	00	Obs.
51		ditto		17			51		ditto		21		
52		ditto		17			52		ditto		21		Ac.
53		ditto		17			53		ditto		21		
54		ditto		18		Ac.	54		ditto		22		Obs.
55		ditto		18			55		ditto		22		
56		ditto		18			56		ditto		22		Ac.
57		ditto		19			57		ditto		23		Obs.
58		ditto		19		Obs.	58		ditto		23		
59		ditto		19			59		ditto		23		
50	00	20	00	18	00	Ac.	50	00	28	00	22	00	Ac.
51		ditto		18			51		ditto		22		
52		ditto		18		Obs.	52		ditto		22		
53		ditto		19			53		ditto		23		Obs.
54		ditto		19			54		ditto		23		
55		ditto		19			55		ditto		23		Ac.
56		ditto		19		Ac.	56		ditto		23		
57		ditto		19			57		ditto		24		Obs.
58		ditto		20			58		ditto		24		
59		ditto		21		Obs.	59		ditto		24		
50	00	22	00	19	00	Obs.	50	00	30	00	23	00	Ac.
51		ditto		19		Ac.	51		ditto		23		
52		ditto		19			52		ditto		23		
53		ditto		20		Obs.	53		ditto		24		Obs.
54		ditto		20		Ac.	54		ditto		24		Ac.
55		ditto		20			55		ditto		24		
56		ditto		20			56		ditto		24		
57		ditto		20			57		ditto		25		Obs.
58		ditto		21		Obs.	58		ditto		25		
59		ditto		21			59		ditto		25		Ac.



*Variation of the Compass.*

Lat.		Long.		Variat.			Lat.		Long.		Variat.		
D.	M.	D.	M.	D.	M.		D.	M.	D.	M.	D.	M.	
50	00	32	00	24	00	Ac.	51	00	42	00	29	00	Obs.
51		ditto		24		Obs.	52		ditto		29		Ac.
52		ditto		24			53		ditto		30		
53		ditto		24			54		ditto		30		
54		ditto		25		Ac.	55		ditto		30		Obs.
55		ditto		25			56		ditto		30		
56		ditto		25			57		ditto		31		
57		ditto		26		Obs.	58		ditto		31		Obs.
58		ditto		26		Ac.	59		ditto		31		
59		ditto		26		Obs.	52	00	44	00	30	00	Obs.
50	00	34	00	25	00	Obs.	53		ditto		31		Ac.
51		ditto		25		Ac.	54		ditto		31		
52		ditto		25		Obs.	55		ditto		31		
53		ditto		25			56		ditto		31		Obs.
54		ditto		26			57		ditto		32		
55		ditto		26		Obs.	58		ditto		32		Ac.
57		ditto		26		Ac.	59		ditto		32		
58		ditto		27			53	00	46	00	31	00	Ac.
59		ditto		27			54		ditto		32		Obs.
50	00	38	00	27	00	Obs.	55		ditto		32		Ac.
51		ditto		27			56		ditto		32		
52		ditto		27			57		ditto		33		Obs.
53		ditto		28		Ac.	58		ditto		33		
54		ditto		28		Ac.	59		ditto		33		
55		ditto		28			56	00	48	00	32	00	Obs.
56		ditto		28			57		ditto		32		Obs.
57		ditto		29		Obs.	58		ditto		32		
58		ditto		29		Obs.	59		ditto		34		
59		ditto		30			60		ditto		34		Obs.
50	00	40	00	28	00	Ac.	61		ditto		34		
51		ditto		28		Obs.	57	00	50	00	33	00	Obs.
52		ditto		28		Ac.	58		ditto		33		Obs.
53		ditto		29			59		ditto		33		
54		ditto		29			60		ditto		34		
55		ditto		29		Obs.	61		ditto		35		
56		ditto		29									
57		ditto		30									
58		ditto		30		Obs.							
59		ditto		30									



Lat.		Long.		Variat.			Lat.		Long.		Variat.		
D.	M.	D.	M.	D.	M.		D.	M.	D.	M.	D.	M.	
58	00	52	00	34	00	Obs.	59	00	68	00	40	00	Obs.
59		ditto		34			60		ditto		43		Jon's Streights.
60		ditto		34			61		ditto		44		
61		ditto		35			62		ditto		47		
62		ditto		35									
58	00	54	00	34	00	Obs.	60	00	70	00	43	00	Obs.
59		ditto		35			61		ditto		44		
60		ditto		36			62		ditto		47		
61		ditto		36									
62		ditto		36			61	00	72	00	42	00	Obs.
							62		ditto		43		
							63		ditto		48		
58	00	56	00	36	00	Obs.	62	00	74	00	41	00	Hudson's Streights.
59		ditto		36			63		ditto		48		
60		ditto		36									
61		ditto		37			62	00	76	00	41	00	
62		ditto		37			63		ditto		47		Obs.
							64		ditto		49		
							62	00	78	00	40	00	
58	00	58	00	36	00	Obs.	63		ditto		42		Obs.
59		ditto		37			64		ditto		49		
60		ditto		37									
61		ditto		37			63	00	80	00	40	00	
62		ditto		38			64		ditto		49		Obs.
63		ditto		38									
							60	00	82	00	38	00	
							61		ditto		39		
58	00	60	00	37	00	Obs.	62		ditto		40		Obs.
59		ditto		38			63		ditto		42		
60		ditto		38			64		ditto		44		
62		ditto		38									
63		ditto		39			50	00	84	00	19	00	In Hudson's Bay.
							51		ditto		20		
58	00	62	00	38	00	Obs.	51		ditto		21		
59		ditto		39			52		ditto		22		
60		ditto		39			53		ditto		23		
61		ditto		39			54		ditto		24		
62		ditto		40			55		ditto		25		
							56		ditto		26		
59	00	64	00	39	00	Obs.	57		ditto		27		
60		ditto		39			58		ditto		27		
61		ditto		39			59		ditto		28		
62		ditto		40			60		ditto		29		
							61		ditto		30		Hud-
60	00	66	00	40	00	Obs.	62		ditto		40		
61		ditto		41									
62		ditto		43									



Variation of the Compass.

Lat.		Long.		Variat.			Lat.		Long.		Variat.		
D.	M.	D.	M.	D.	M.		D.	M.	D.	M.	D.	M.	
55	00	86	00	22	00	Obs.	57	00	90	00	21	00	Obs.
56		ditto		23		In Hudson's Bay.	58		ditto		22		In Hudson's Bay.
57		ditto		24			59		ditto		23		
58		ditto		25			60		ditto		24		
59		ditto		26									
60		ditto		27									
56	00	88	00	22	00								
57		ditto		23									
58		ditto		24									
59		ditto		25									
60		ditto		26									

Note, The Letters Obs. are the Observations, and the Letters Ac. are by Estimation.

An Unusual Agitation in the Magnetic Needle, observed to last for some Time, in a Voyage from Maryland, by Capt. Walter Hoxton No. 417. p. 53.

VII. On the second of September, 1724, a little after Noon, being in Latitude  $41^{\circ} 10'$  N. and Difference of Longitude from Cape Henry in Virginia about  $28^{\circ} 00'$  E. the Weather fair, a moderate Gale, and smooth Sea, my Mate, who was on the Deck, came and told me, that the Compass traversed so much that he could not possibly steer by it: Whereupon I went up, and after trying it in several Parts of the Ship, found what he said to be true. I then had all my Compasses brought up, and placed in different Parts of the Ship, and in Places most remote from Iron, and, to my great Surprise found them all in the same Condition; so that we could not steer by any of them. I then new touched some of them with a Loadstone, which I always carry with me; and lest that should affect them, sent it out to the End of the Bowsprit; but I did not perceive that the new touching was of any Service, for they all continued traversing very swiftly, for about an Hour after I came on the Deck, and then on a sudden every one of them stood as well as usual. During the whole Time, the Ship had very little Motion; and I had an Azimuth Compass, and four or five others.

An Account of a Treatise intituled, Calculations and Tables relating to the attractive Virtue of Loadstones, &c. Printed Anno 1729. No. 412. pag. 245.

VIII. The Author, (the Hon. Lord Paisley) by several Experiments very carefully made, has observed, that if two Loadstones are perfectly homogeneous, that is, if their Matter be of the same specific Gravity, and of the same Virtue in all Parts of one Stone, as in the other, and that like Parts of their Surfaces are capped or armed with Iron, then the Weights they sustain will be as the Squares of the Cube Roots of the Weights of the Loadstones; that is, as their Surfaces. Upon this Principle the Tables are formed. The first Column of these Tables is in common to the four following, and helps to shew how many times it's Weight any Loadstone sustains.



In the second, third, fourth and fifth Columns, are the Weights of Load-stones in different Denominations. The second, intituled Grains, reaches Grain by Grain to 480 Grains, or one Ounce, and will serve for any Load-stone, whose Weight does not exceed one Ounce. The third reaches, by Penny-weights, up to two Pounds, or 480 Penny-weights, and therefore serves for any Stone that weighs not less than one Penny-weight, nor more than two Pound. The fourth Column reaches, by Ounces, up to forty Pounds, or 480 Ounces, and therefore will serve for any Stone not exceeding that Weight. The fifth serves from one to 480 Pounds, The sixth Column intituled, Weight sustained, is in common to the four preceding; and the Numbers in this Table, if they were divided by 10, would be the Squares of the Cube Roots of the Numbers in natural Order, from 1 to 480, as they are found in the Column of Pounds. But these Squares of the Cube Roots are here multiplied by ten, because a Load-stone of the very worst Sort, if it weighs but one Grain, will sustain ten Grains; and so these Tables, by simple Inspection, shew what Number of Grains any Load-stone of that worst Character would sustain, if the Stone weigh not more than 480 Grains, or one Ounce. The Numbers in the first Column intituled, How often it's Weight, are proportional to the Reciprocals of the Cube Roots of the natural Numbers, and are formed by dividing the Numbers of the sixth Column, by the corresponding natural Numbers, as they are found in the Column of Pounds.

For the greater Convenience of Calculation, his Lordship has added Tables; first of Decimal Parts for Penny-weights, Ounces, and Pounds, in order to lose as little as possible of the Fractions, in the several Calculations. The next are Tables of Grains, Penny-weights, Ounces, and Pounds, which readily shew how many of each Denomination are contained in the others. The Tables intituled, From Grains to Penny-weights, &c. and the others from the several Denominations to others, are of Use for carrying the Computation readily from any one Denomination to another: And lastly, the Tables at the Bottom of these last mentioned are of the like Use, for the ready finding the Value in Money of any Load-stone, from the Numbers proper to Grains, to Penny-weights, to Ounces, and to Pounds.

The Honourable Author then proceeds to explain the Use of these Tables, by Instances under each Denomination. Thus, if a Load-stone does not exceed one Ounce, or 480 Grains, the particular Weight of the Stone, with the Weight it sustains, being known, he reduces the Weight sustained to Grains, by the Help of the Table of Grains. Then looking into the Column of Grains for the Weight of the Stone, against it, in the Column of Weight sustained,



he finds the Number of Grains, which a Stone of the worst Sort of this Weight would sustain; and then dividing the known Number of Grains which this particular Stone will sustain, by the Number of Grains expressed in the Column, the Quotient shews the Character of Goodness in the Stone proposed; and by the Help of this Number may be known what Weight any other Stone of equal Goodness with this would sustain, let it's Weight be less or more, provided it does not exceed one Ounce, or 480 Grains. For looking into the second Column for the Weight of the Stone, and having found against it, in the sixth Column, the Weight sustained by a bad Stone, if you multiply the Quotient above found, which shews the Character of Goodness, by the Number in the Tables expressing the Weight sustained, the Product is the Number of Grains this particular Stone will sustain.

If a Stone of the same Character weighs more than one Ounce, or 480 Grains, and less than two Pound, to know what Weight this will sustain, the Computation must be transferred from the Column of Grains to that of Penny-weights. Now since one Penny-weight is equal to twenty-four Grains, and the Weight sustained is to be expressed, not in Grains, but in Penny-Weights, the former Number, which gives the Character of Goodness of the Stone for Grains, must be altered, to do the same thing for Penny-weights. Multiplying therefore this Number by the Reciprocal of the Cube Root of 24, the Number of Grains contained in one Penny-weight (and the Numbers in the Tables are formed accordingly) the Product gives the Number shewing the Character of Goodness in this Stone, which being found, the remaining Part of the Operation is the same as in the former.

If a Loadstone exceeds 480 Penny-weights, and is less than forty Pound, we must in like manner find the Number of the Stone for Ounces; which may be done either by the Number already found for Grains, multiplying it by the Number against Unit in the Table from Grains to Penny-weights, or by the Number for Penny-weights, multiplying it by the Number against Unit in the Table from Penny-weights to Ounces, and the Product is the Characteristic Number of this Stone. Proceeding therefore as in the first Instance, the Weight it will sustain will be found.

The Column of Pounds is only useful where a Loadstone's Weight exceeds forty Pound, or 480 Ounces, in which Case the same Method must be used as in the others.

To know how many times a Loadstone will take up it's own Weight, multiply the Number proper to the Denomination in Use, by the Number in the first Column (intituled, How often it's Weight) which is against the Weight of the Stone in the Column of that Denomination.



His Lordship closes his Account with explaining the Use of the Tables relating to the Value of Load-stones in Money; and this he supposes to be in the compound Proportion of the Goodness of the Stone, and of the Weight it sustains; because if two Load-stones take up the same Weight, the lesser is more valuable, as it does more in Proportion to it's Bulk, and what better Rule to estimate the Value by, than the Goodness of the Stone? On the other Hand, if the Stones are in Nature equally good, but sustain different Weights, it is reasonable, that their Value should be according to the Weights they sustain. Both these Circumstances therefore being considered together, in order to find the Value of any Load-stone by the Tables, we must multiply the characteristic Number for the Stone, by the Number intituled, Value in Money, taking this Value in Money from the particular Denomination that the Stone comes under; and this Product will be the Value, *per* Ounce, of what the Stone sustains. Then multiplying this Value *per* Ounce, by the Number of Ounces the Stone sustains, will give the Value in Money of the Stone proposed.



## CHAP. V.

## BOTANY.

I .1. **T**HE Poyson-Wood-Tree grows only in Swamps, or low wet Grounds, and is something like a small Ash, but much more like a *Sumach*, and therefore is by some called the *Swamp Sumach*, for the Twiggs, Leaves, and Shape are exactly like the *Sumach*, and it likewise bears a dry Berry.

It never grows bigger than a Man's Leg, nor taller than Alder but spreads much, and several together, especially about the Stump or Roots of one that is cut down; as it is of quick growth, so it does

*An Account of the Poyson-Wood Tree in New-England. By the Hon. Paul Dudley, Esq; F. R. S. No. 367. p. 145.*



*An Account of the Poyson Wood Tree in New-England.*

not last long; the inside of the Wood is yellow and very full of Juice, as glutinous as Honey or Turpentine; the Wood itself has a very strong unsavory Smell, but the Juice stinks as bad as Carrion. Having thus described the Tree, we shall now proceed to give an account of it's Poisonous Quality, &c.

1. And first, it must be observed, that it poysons two ways, either by touching or handling of it, or by the Smell; for the Scent of it, when cut down in the Woods, or on the Fire, has poisoned Persons to a very great degree. One of my Neighbours was blind for above a Week together, with only handling it. And a Gentleman in the Country, sitting by his Fire-side in the Winter, was swelled for several Days with the Sinoak or Flame of some Poyson-Wood that was in the Fire.

2. A second thing to be remarked of the Poyson-Wood is, that it has this effect only on some particular Persons and Constitutions; for I have seen my own Brother not only handle, but chew it without any harm at all. And so by the same Fire one shall be poisoned and another not at all affected.

3. But then Thirdly, this sort of Poyson is never Mortal, and will go off in a few Days of it self, like the Sting of a Bee; but generally the Person applies Plantain Water, or Sallet-Oyl and Cream.

4. As to it's Operation, within a few Hours after the Person is poysoned, he feels an itching Pain that provokes a Scratching, which is followed by an Inflammation and Swelling; sometime a Man's Legs only have been poysoned, and have run with Water.

My Neighbour that was so sadly poysoned with handling it, told me one thing very remarkable of the Wood, and that is, that when he touched it, he plainly perceived it to differ from the other Wood, that he was throwing up into his Cart; for it was as cold as a piece of Ice; and withal assured me, he could distinguish it blindfold, or in the dark, from any other Wood in the World, by it's Coldness; but the poor Man is as much afraid of it, when he goes into the Woods, as of a Rattle-Snake. He further tells me, that he felt an itching in a few Hours after he had handled the Wood, but the swelling did not come on till in about three Days.

2. The Account I had of the Poyson-Tree from Mr *More* (which probably he had from Mr *Dudley*) is as follows.

The Poyson-Tree grows to the bigness of Elder; I never saw the Leaf; the Wood is as cold as Ice. When laid on the Fire, of 5 or 6 Persons sitting by it, some will fall a swooning, fainting, or yawning, continuing so for some Days, others but a few Hours, and others of the Company not at all. I handle, cut and burn it with impunity; and so it is with several others, I suppose, according to their several Constitutions. It was never known to kill any Body, but

*A Farther Account of the same Tree. By William Sheppard, L. L. D. R. S. S. No. 367. p. 147.*



only to do hurt to some Persons. I have sent you all the Seeds of it, I can get.

The Seeds he sent were but few, but I had a good quantity from Mr. Catesby in Carolina. He calls it a Water Shrub, of which he never saw Leaf or Flower. 'Tis a species of *Toxicodendron*, tho' not nam'd by Dr Tournefort in his Institutions, p. 610. but I believe it to be *Arbor Americana alatis foliis, succo lacteo, venenata*. Pluknet. Almag. 45. Tab. 145. Fig. 1. which is a Species of *Toxicodendron* that grew formerly at Chelsey Garden. What makes me think it to be this, is Mr Dudley's writing 'tis like a *Sumach*, and that it is by some called the *Swamp Sumach*; this in its manner of growing and alated Leaves, very much resembles the *Sumach* or *Rhus*; the Fruit is a white roundish dry Berry, growing in Clusters, so like that of *Toxicodendron triphyllon folio sinuato, pubescente*, Inst. R. Herb. 611. *Hederæ trifoliæ Canadensi affinis planta: Arbor venenata quorundam H. R. Paris.* as scarce to be distinguished from it.

II. 1. The Flower is of the Lilly Kind, monopetalous *infundibuliformis*, without any *Calyx* or *Perianthium*, it's long fistulous Beginning being afterwards expanded into six beautiful oblong Segments. A.A.

The *Petalum* is distinguished into a long, hollow or fistulous Part, which lies inclosed within the common and proper *Involucra* of the Plant, arising from the Top of the *Ovarium*, or *Seed-Vessel*, and six Segments. a. a.

While this narrow, tubulous Part runs between the Leaves and Integuments that surround them, it is of a white Colour; but, as soon as it is disengaged from these, it insensibly acquires a Purple Colour, which, a little before it's Division, as it begins to be enlarged, and grow more open, inclines to a Red.

This narrow fistulous Part of the Flower, about 1 or 2 Inches above the *Theca Communis*, forms six foliaceous Segments, or divides into so many oblong Purple-coloured *Petala*. b. c.

Three of these Flower-Leaves are larger than the other three, but in all other Respects, are much alike. c. c. c.

The Length of the largest is from 1  $\frac{3}{4}$ , to 2 Inches; the Breadth seldom above  $\frac{1}{2}$  Inch: The shorter Leaves are from 1, to 1  $\frac{1}{4}$  Inch in Length, their Breadth being something less in Proportion.

The Inside of each *Petalum* is of a Violet Purple-Colour, vein'd with a few small Lines of a deeper Dye, running length-ways, intermixed with White, or the whole is beautifully checquered with Blue; and White Colours.

The Outside is of a whiter Blue, with several whitish Risings or Ridges, and just at the Bottom of the Leaf it is of a deeper Blue; the three small Leaves b. b. b. are much of the same Colour, only the Purple seems to be something deeper.

A Description  
of the Flower  
and Seed Ves-  
sel of the  
Plant, called  
*Crocus Au-  
tumnalis Sati-  
vus*, that pro-  
duces the true  
English Saf-  
fron of the  
Shops: By  
James  
Douglas,  
M. D. F. R. S.  
No. 380. p.  
441.

Fig. 106.  
*Petalon.*



## A Description of the Saffron.

The Number of the *Petala* is, for the most Part, 6; yet, in some Flowers we may observe 7, or 8; but then they are not so large as when they are fewer.

*Stamina.*

In every Flower there are three *Stamina*, or Chives, *d. d. d.* properly so called, arising from the inner Surface of the tubular Part of the Flower, just before it's Division into the *Petala*, where they make, for some Space, an apparent Ridge, and then they stand upright, opposite to the three large Leaves; they are of a whitish Colour, inclining to a light Purple, being but little above  $\frac{1}{4}$  of an Inch in Length.

In those Plants that have 7 or more *Petala*, the Number of the *Stamina* is likewise encreased to 5, or more.

*Apices.*

Each of these *Stamina* has it's proper *Apex*, *e. e. e.* which is a peculiar longish Substance, standing upright, opposite to the larger Flower-Leaves, of a Yellow Colour, forked, not unlike the Tongue of a small Bird, at the lower End, where it is fixed to the *Stamen*; here likewise it is broadest, but as it ascends it becomes narrower, and it's upper Extremity is a little crooked, or turned to one Side: It seldom exceeds  $\frac{1}{2}$  Inch in Length.

It appears as if it was double, with a longitudinal Furrow in the middle, in which Hollow the *Stamen* seems to be faintly continued for some Space.

When the Plant is full grown, they are all loaded with that Kind of small Dust called *Farina fecundans*.

*Ovarium.*

*Ovarium*, called likewise the *Vasculum Seminale*, and *Pistillum* by some, *ff*,

Is a particular Body, which arises from the Top of the *Pedunculus*, *g.* about  $\frac{1}{4}$  of an Inch long, or a little more, of a deep White Colour, three cornered, and divided into three *Loculamenta*, or *Capfulæ*, in which the Seeds (which however seldom come to Perfection with us) are formed, growing bigger and bigger after the Flower falls off; nay, even in this blooming State, if you cut this Vessel across the middle, you may perceive the whitish Rudiments of the Seeds.

*Stylus*

From the upper Part, or *Apex*, of the *Ovarium*, arises the *Stylus*, *b.* which is a long slender Tube, that lies enclosed within the tubulous or fistular Portion of the Flower, being there of a whitish Colour, but changing into a Yellow before it's Division.

This Style ordinarily splits into 3 Parts, just opposite to the Top of the *Stamina*, where the *Apices* take their Rise, *i. i. i.* and thus far it stands upright in the Middle of the *Stamina*; for the sake of which only, this Plant is cultivated, and being prepared, (as shall hereafter be described) makes the true Saffron of the Shops, which we so frequently use in Physic.

I call these Parts of the *Stylus*, from their Figure and Shape, *Capillamenta Tubiformia*, or, *Appendices Styli Salpingoeides*, in as much as they very exactly represent a Trumpet, and are not unlike the *Fallopian*



Fig. 91.

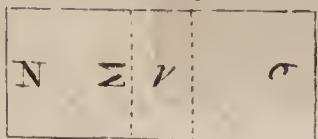


Fig. 92.

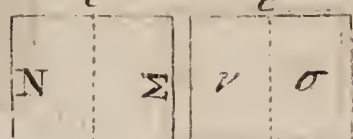


Fig. 93.



Fig. 94.

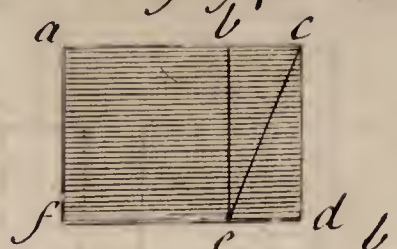


Fig. 95.

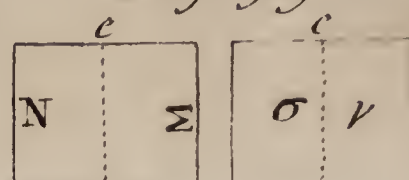


Fig. 96.

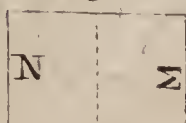


Fig. 97.

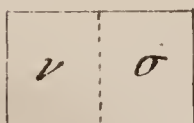
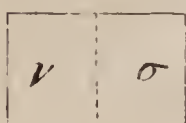
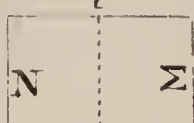


Fig. 98.

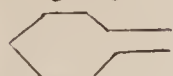


Fig. 99.

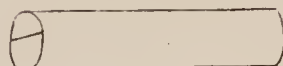


Fig. 100.



Fig. 101.

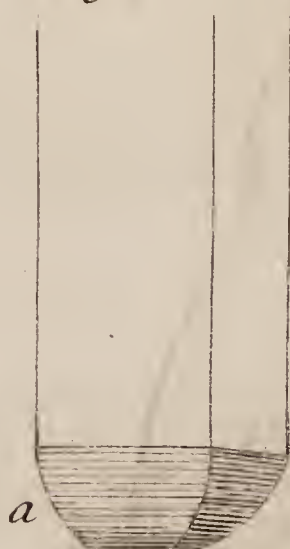


Fig. 102.



Fig. 104.

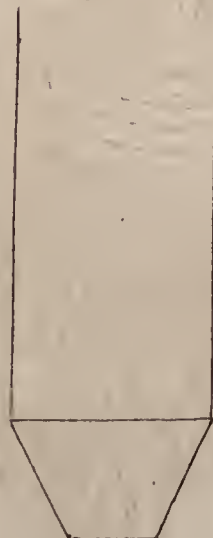


Fig. 105.

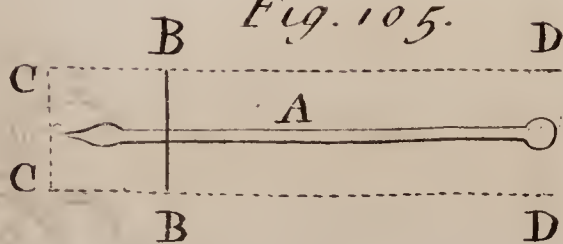


Fig. 106.









*lopian Tube* in Women, being narrow at their Origin, and growing gradually larger towards their other Extremity; which like the common Trumpet, is open and expanded; and, like the *Tubæ Falloppii*, is jagged, or fringed at the Edge. *Vid. Lit. k, k, k.*

It may also be very fitly named *Crocus officinarum*, because that is the Part only that is used in the Shops.

They are of a Yellow Colour, just at their Beginning, continued from the upper Part of the *Stylus*, but afterward they are all of a deep Red Colour, only their jagged Extremities are tipped with White inclining to a Yellow.

These *Tubæ*, or *Capillamenta*, are from 1, to 1 ½ Inch in Length.

The *Stylus*, while undivided, is strong enough to support itself, being enclosed within the tubular Part of the Flower; but the *Capillamenta* being very weak and slender at their Beginning, this occasions them to hang down between the *Petala*.

The Figure represents a Root of the Saffron-Plant, that has two Stalks enclosed in one common *Vagina*, the whole Flower with the *Stamina* and *Apices* in one, and the *Stylus* only in the other; with the *Leaves*, *Pedunculi*, and *Ovarium* in both, being fairly delineated from the Life.

*A. A. The Flower expanded into six beautiful Segments. a. a. The Fistulous Part of the Flower. b. c. The six Petala. c. c. c. The three larger Petala. b. b. b. The three smaller ones. d. d. The three Stamina, or Chives. e. e. e. The three Apices. f. f. The Vasculum Seminale. g. g. The Pedunculi. h. h. The Stylus. i. i. i. The three Capillamenta Tubiformia. k. k. k. The jagged Extremity of the Capillamenta. B. B. The Root. C. C. The Grassy Leaves.*

2. As Saffron grows at present most plentifully in *Cambridgeshire*, and has grown formerly in several other Counties of *England*, the Method of Culture does not I believe, vary much in any of them, and therefore I have judged it sufficient to set down here the Observations which I employed proper Persons, in different Seasons, to make in the Years 1723, 24, 25, and 28, up and down all that large Tract of Ground that lies between *Saffron-Walden* and *Cambridge*, in a Circle of about ten Miles Diameter. In that Country Saffron has been longest cultivated, and therefore it may reasonably be expected that the Inhabitants thereof are more thoroughly acquainted with it than they are any where else.

I shall begin with the Choice and Preparation of the Ground. The greatest Part of the Tract already mentioned is an open, level Country with few Inclosures; and the Custom there is, as in most other Places, to crop two Years, and let the Land lie fallow the third. Saffron is always planted upon fallow Ground, and all other Things being alike, they prefer that which has born Barley the Year before.

The



The Saffron grounds are seldom above three Acres, or less than one, and in choosing them, the principal Thing they have Regard to is, that they be well exposed, the Soil not poor, nor a very stiff Clay, but a temperate dry Mold, such as commonly lies upon Chalk, and is of a hazel Colour; though if every Thing else answers, the Colour of the Mold is pretty much neglected.

The Ground being made choice of, about Lady-day, or the Beginning of *April*, it must be carefully ploughed, the Furrows being drawn much closer together and deeper, if the Soil will allow it, than is done for any Kind of Corn, and accordingly the Charge is greater.

About five Weeks after, or during any Time in the Month of *May*, they lay between twenty and thirty Loads of Dung upon each Acre, and having spread it with great Care, they plough it in as before. The shortest rotten Dung is the best; and the Farmers who have the Conveniencies of making it, spare no Pains to make it good, being sure of a proportionable Price for it. About Midsummer, they plough a third Time, and between every sixteen Foot and an half, or Pole in Breadth, they leave a broad Furrow or Trench, which serves both for a Boundary to the several Parcels, (when there are several Proprietors to one Enclosure) and to throw the Weeds in at the Proper Season.

To this Head likewise belongs the Fencing of the Grounds, because most commonly, though not always, that is done before they plant. The Fences consist of what they call dead Hedges, or Hurdles to keep out not only Cattle of all Sorts, but especially Hares, which would otherwise feed on the Saffron Leaves during the Winter.

About the Weather we need only observe, that the hottest Summers are certainly the best, and if therewith there be gentle Showers from time to time, they can hardly miss of a plentiful rich Crop, if the extream Cold, Snow, or Rain of the foregoing Winter have not prejudiced the Heads.

The next general Part of the Culture of Saffron, is planting or setting the Roots; the only Instrument used for which, is a narrow Spade, commonly termed a *Spit-shovel*.

The Time of Planting is commonly in the Month of *July*, a little sooner or later, according as the Weather answers. The Method is this. One Man with his Spit-shovel raise, between three and four Inches of Earth, and throws it before him about six, or more Inches; two Persons, generally Women, following him with Saffron-heads, place them in the farthest Edge of the Trench he makes at three Inches distance from one another, or thereabouts. As soon as the Digger or Spitter has gone once the Breadth of the Ridge, he begins again at the other Side, and digging as before, covers the Roots last set, and makes the same Room for the Setters to place a new Row, at the same



same Distance from the first, that they are from one another. Thus they go on till a whole Ridge, containing commonly one Rod, is planted, and the only Nicety in digging is to leave some Part of the first *Stratum* of Earth untouched to lie under the Roots; and in setting, to place the Roots directly upon their Bottoms. What Sort of Roots are to be preferred, shall be shown under the fourth Head; but it must be observed in this Place, that formerly when Roots were very dear, they did not plant them so thick as they do now; and that they have always some Regard to the Size of the Roots, placing the largest at a greater Distance than the small ones.

The Quantity of Roots planted in an Acre is generally about sixteen Quarters, or 128 Bushels, which according to the Distances left between them, as before assigned, and supposing them all to be an Inch in Diameter one with another, ought to amount to 392040 in Number.

From the Time that the Roots are planted, till about the Beginning of *September*, or sometimes later, there is no more Labour about them; but as they then begin to spire, and are ready to shew themselves above Ground, which is known by digging a few out of the Earth, the Ground must be carefully pared with a sharp Hough, and the Weeds, &c. raked into the Furrows, because otherwise they would hinder the Growth of the Plants.

In some Time after appear the Saffron Flowers, and this leads us to the third Branch of our present Method. The Flowers are gathered as well before, as after they are full blown, and the most proper Time for this, is early in the Morning. The Owners of the Saffron get together a sufficient Number of Hands, who place themselves in different Parts of the Field, pull off the whole Flowers, and throw them Handful by Handful into a Basket; and so continue till all the Flowers are gathered, which happens commonly about ten or eleven o'Clock.

Having then carried home all they have got, they immediately spread them upon a large Table, and placing themselves round it, they fall to picking out the Filamenta, Styli, or Chives, and together with them, a pretty long Portion of the Stylus itself, or *String* to which they are joined. The rest of the Flower they throw away as useless. The next Morning they return into the Field again, whether it be wet or dry Weather, and so on daily, even on *Sundays*, till the whole Crop be gathered.

The Chives being all picked out of the Flowers, the next Labour about them is to dry them on the Kiln. The Kiln is built upon a thick Plank (that it may be moveable from Place to Place) supported by four short Legs. The Outside consists of eight Pieces of Wood, about three Inches thick, joined in Form of a quadrangular Frame, about twelve Inches square at Bottom on the Inside, and twenty-two Inches at Top, which is likewise equal to the perpendicular



lar Height of it. On the Foreside is left a Hole about eight Inches square, and four Inches above the Plank, through which the Fire is put in. Over all the rest, Laths are laid pretty close to one another, and nailed to the Frame already mentioned, and then are plaistered over on both Sides, as is also the Plank at Bottom very thick, to serve for a Hearth. Over the Mouth, or widest Part, goes a Hair-Cloth fixed to two Sides of the Kiln, and likewise to two Rollers, or moveable Pieces of Wood, which are turned by Wedges or Screws, in order to stretch the Cloth. Instead of the Hair-Cloth many People now use a Net-work of Iron-wire, with which it is observed, that the Saffron dries sooner, and with a less Quantity of Fewel; but the Difficulty of preserving the Saffron from burning, makes the Hair-Cloth be preferred by the nicest Judges in drying.

The Kiln is placed in a light part of the House, and they begin by laying five or six Sheets of white Paper on the Hair-Cloth, upon which they spread the wet Saffron, between two and three Inches thick. This they cover with other Sheets of Paper, and over these lay a coarse Blanket five or six times doubled, or instead thereof, a Canvas Pillow filled with Straw, and after the Fire has been lighted for some time, the whole is covered with a Board, having a large Weight upon it.

At first they give it a pretty strong Heat, to make the Chives sweat, as their Expression is; and in this, if they do not use a great deal of Care, they are in danger of scorching, and so of spoiling all that is on the Kiln.

When it has been thus dried for about an Hour, they take off the Board, Blanket, and upper Papers, and take the Saffron off from that which lies next it, raising at the same time the Edges of the Cake with a Knife. Then laying on the Papers again, they slide in another Board between the Hair-Cloth and under-Papers, and turn both Papers and Saffron upside down, afterwards covering them as above.

This same Heat is continued for an Hour longer; then they look to the Cake again, free it from the Papers and turn it; then they cover it, and lay on the Weight as before. If nothing happens amiss, during these first two Hours, they reckon the Danger to be over; for they have nothing more to do, but to keep a gentle Fire, and turn their Cake every half Hour, till it be thoroughly dry; for doing which as it ought, there are required full twenty-four Hours.

In drying the large plump Chives they use nothing; but towards the latter End of the Crop, when these come to be smaller, they sprinkle the Cake with a little small Beer, to make it sweat as it ought; and they begin now to think, that using two linnen Cloths next the Cake, instead of the two innermost Papers, may be of some



some Advantage in drying ; but this Practice is followed as yet but by few.

Their Fire may be made of any kind of Fewel ; but that which smoaks the least is best, and Charcoal for that Reason is preferred to any other.

What Quantity of Saffron a first Crop will produce is very uncertain. Sometimes five or six Pounds of wet Chives are got from one Rod ; sometimes not above one or two, and sometimes not enough to make it worth while to gather and dry it. But this is always to be observed, that about five Pounds of wet Saffron go to make one Pound of dry, for the first three Weeks of the Crop, and six Pounds during the last Week ; and now the Heads are planted very thick, two Pounds of dried Saffron may, at a Medium, be allowed to an Acre for a first Crop, and four and twenty Pounds for the two remaining, the third being considerably larger than the second.

In order to obtain these, there is only a Repetition to be made every Year of the Labour of houghing, gathering, picking and drying, in the same manner as before set down, without the Addition of any thing new ; except that they let Cattle into the Fields, after the Leaves are decayed, to feed upon the Weeds ; or perhaps mow them for the same Use.

About the *Midsummer* after the third Crop is gathered, the Roots must all be taken up and transplanted : The Management requisite for which is the fourth Thing to be treated of. To take up the Saffron Heads, or break up the Ground, as their Term is, they sometimes plough it, sometimes use a forked Kind of Hough called a Pattock, and then the Ground is harrowed once or twice over ; during all which Time of ploughing, or digging and harrowing, fifteen or more People will find Work enough to follow and gather the Heads as they are turned up.

They are next to be carried to the House in Sacks, and there to be cleaned or raised. This Labour consists in clearing the Roots thoroughly from Earth, and from the Remains of old Roots, old Involucra, and Excrescencies ; and thus they become fit to be planted in new Ground immediately, or to be kept for some Time without Danger of spoiling.

The Quantity of Roots taken up, in Proportion to those that were planted, is uncertain ; but at a Medium it may be said, that allowing for all the Accidents that happen to them in the Ground, and in breaking up, from each Acre may be had twenty-four Quarters of clean Roots, all fit to be re-planted. The Owners are sure to choose for their own Use the largest, plumpest, and fattest Roots, but above all, they reject the longish pointed ones, which they call *Spickets* or *Spickards* ; for very small round or flat Roots are sometimes observed to flower.



## *The Culture and Management of Saffron in England.*

This is the whole Culture of Saffron in the Country above-mentioned; and we have only now to consider the Charges and Profits which may be supposed, one Year with another, to attend this Branch of Agriculture; and of these I have drawn up the following Computation for one Acre of Ground, according to the Price of Labour in this County.

	l.	s.	d.
Rent for three Years	3	0	0
Ploughing three Times	0	18	0
Dunging	3	12	0
Hedging	1	16	0
Spitting and setting the Heads	1	12	0
Weeding, or paring the Ground	1	4	0
Gathering and picking the Flowers	6	10	0
Drying the Flowers	1	6	0
Instruments of Labour for three Years with the Kiln, about	0	10	0
Ploughing the Ground once and har- rowing twice	0	12	0
Gathering the Saffron Heads	1	00	0
Raising the Heads	1	12	0
Total Charge	23	12	0

This Calculation is made upon the Supposition, that an Acre of Ground yields twenty six Pounds of neat Saffron in three Years, which I stated only as a mean Quantity between the greatest and the least; and therefore the Price of Saffron must be adjusted accordingly, which I think cannot be done better than by fixing it at thirty Shillings *per* Pound; since in very plentiful Years it is sold for twenty, and is sometimes worth between three and four Pounds. At this Rate, twenty-six Pounds of Saffron are worth thirty-nine Pounds, and the neat Profits of an Acre of Ground producing Saffron, will in three Years amount to fifteen Pounds thirteen Shillings, or to about five Pounds four Shillings yearly. This, I say, may be reckoned the neat Profit of an Acre of Saffron, supposing that all the Labour were to be hired for ready Money; but as the Planter and his Family do a considerable Part of the Work themselves, some of this Expence is saved: That is, by planting Saffron, he not only may reasonably expect to clear about five Pounds yearly *per* Acre, but also to maintain himself and Family for some Part of each Year; and it is upon this Supposition only, that the Result of other Computations which have been made of the Profits of Saffron, can be said to have any tolerable Degree of Exactness; but the Calculations themselves are undoubtedly very unaccurate.

I have said nothing here concerning the Charge in buying, or Profits in selling the Saffron Heads, because in any large Tract of Ground these



these must at length always ballance one another, while the Quantity of Ground planted yearly continues the same, which has been pretty much the Case for several Years past.

III. Agnus dictus Vegetabilis Scythicus, Barbaro nomine *Borametz* *A Dissertation on the Scythian Lamb,* *Borometz* vel *Boranetz* inter Historiæ Nat. Scriptores est notus. *by Joh. Phil. Breynius, M. D. Dintisc. F. R. S. No. 390. pag. 353.*

De hoc imprimis egerunt Athanasius Kircherus in Opere de Arte Magnetica, (a) qui citat Sigismundum L. B. ab Herberstein, Hay-tonem Armenum, Surium & Jul. Cæs. Scaligerum, Franciscus Baco de Verulamio, (b) Fortunius Licetus, (c) Andreas Libavius, (d) Eusebius Nierenbergius, (e) Adamus Olearius (f) & Olaus Wormius, (g) ut cæteros, quos inter multi Botanici, qui eandem fere canunt cantilenam, nunc taceam.

Hunc Julius Cæs. Scaliger (b) titulo Agni Scythici, Borametz, sequentem in modum describit: “ Superiora ludum putes, prout est  
“ admirabilis Tartaricus frutex. Tartarorum horda primaria Zau-  
“ olha est, vetustissimæ nobilitatis commendatione. In eo agro se-  
“ runt semen feminis Melonis simillimum, sed minus oblongum.  
“ Ex eo satum plantam exire, quam Borametz, id est, agnum vocant.  
“ Crescit enim agni figura ad pedum fere ternum altitudinem: quem  
“ pedibus, ungulis, auribus, toto capite, præterquam cornibus, re-  
“ præsentat. Pro cornibus pilos gerit, singularis cornu specie. Ob-  
“ ducitur corio tenuissimo: cujus detracti usus ad capitum tegmina  
“ incolis. Ferunt internam pulpam Gammari referre carnes. Cæ-  
“ terum è vulnere quoque sanguinem manare. Dulcore esse admi-  
“ rabili. Radicem humo exertam furrigere ad umbilicum usque illud  
“ miraculi fovet magnitudinem. Quandiu vicinis obsiderur herbu-  
“ lis, tamdiu vivere, quasi agnum in læto pascuo. Absumptis illis,  
“ tabescere, atque interire. Idque non solum vel casu, vel tractu  
“ temporis, sed etiam experiundi gratia, subtractis, atque ablatis  
“ evenire. Quin illud auget admirationem: appeti à Lupis eam,  
“ non item ab aliis bestiis, quæ carne vescantur. Hoc quasi con-  
“ dimentum, atque intritum, ad fabulæ, & agni allusionem. Illud  
“ scire velim: Ab uno stirpite, quatuor dissita crura cum suis pedi-  
“ bus qui possint provenire, atque produci.

“ Hæc, quod non ignorarem haud ingrata fore tibi, cæterisque  
“ Philologiæ studiosis, enarravi partim à nobilissimis, partim ab ex-  
“ ercitatissimis in rerum Natura viris non solum lecta, sed etiam  
“ audita: quibus ingenii tui amplissima spatia implere aliqua ex par-  
“ te posses.”

Pari ratione cæteri eum describunt, vel potius ex Scaligero exscri-  
bunt Authores, quorum tamen nonnulli in quibusdam circumstantiis

(a) Pag. 504, & 505. (b) Histor. Natur. Cent. 7. No. 609. (c) De Spontaneo Viventium Ortu. C. 45, (d) Historia Agni Scythiæ. (e) Histor. Natural. p. 34. (f) De Itinere Persico. p. m. 155. (g) Mus. p. 190. (h) De Subtilitate contra Cardanum Exerc. 181. §. 29, & 30.



variant, & Athanasius Kircherus ejusdem addit, vel ut rectius dicam fingit figuram. Imo in nonnullis Rerum Nat. Musæis, ut in Wormiano, Swammerdamiano, &c. ejus, uti volunt, quondam demonstrabatur detracta pellis.

Antonius Deusingius (i) rem accuratiori rationis trutina examinans, fabulosa esse, quæ de Agno hoc traduntur, subolfecit, & ipsum Julium Cæs. Scaligerum, qui inter primos Authores, ut supra dictum, ejus meminit, eum ut fabulam tractasse evincere conatur. Quemadmodum & alii, minus creduli, eundem in dubium vocarunt.

Et revera totam hanc de hoc Agno Historiam, si ab animo præjudiciis vacuo accurate examinetur, fabulam sapere, imo esse, & Deusingium recte judicasse, sequentes evincunt rationes.

1°. Quia à nullo fide digno Authore Agnus ejusmodi Vegetabilis unquam visus. Quæ enim Olaus Wormius (k) narrat ex relatione D. Eovaldi de Kleifs, Electoris Brandenburgici Legati, (ipsi scilicet in confinibus Tartariæ degenti à Tartaro quodam fuisse oblatam ejusmodi plantam exsiccatam, foliis Tabaci, cujus cauli adhærebat fructus, agnellum figura plane referens, magnitudine pedali, vellere crispo tectus) suspecta sunt, cum Vir ille Nobilissimus, ab astuto quodam Tartaro, ipsi fucum faciente facile seduci potuit. Quid verode pellibus, quæ hoc nomine in Musæis demonstrantur, sentiendum sit, ex infra dicendis apparebit.

2°. Quia à Doctiss. & Rerum Nat. Scientissimo Engelberto Kæmpfero, M. D. (l) in supposita hujus Agni patria anxie licet quæsitus, tamen nihil huic simile inventum; hæc enim ejus sunt verba: “ Quia  
“ de existentia Zoophyti gramina pascentis, nullibi Tartariæ apud  
“ vulgum, vel Botanicæ peritos extat notitia & memoria, prout ipse  
“ ad risum & nauseam exploravi, neque ulla res Borometz dicta,  
“ præterquam ovinum pecus ibidem potest reperiri, meram esse,  
“ quicquid de hac planta proditur, fictionem & fabulam asserimus.”

3°. Denique quia tota de hoc Agno relatio fabulæ adeo videtur similis, ac ovum ovo.

Fabulæ autem hujus originem optime detexit diligentissimus Naturæ in Orientalibus Regionibus Scrutator, jam jam laudatus Kæmpferus loc. cit. ubi (præmissis de Etymologia vocis Borometz, quod corruptum ait ex Moscovitico Boranetz, Polonicè Baranek, quod diminutivum est vocus Baran Sclavonicæ originis, Polonis Russisque ovem significantis) ait, in quibusdam Provinciis circa Caspium Mare esse quoddam ovium genus, præter vulgare nobis cognitum, quod ab eo in multis discrepat, imprimis commendabile pellium

(i) De Agno Vegetabili, quod extat in Fasciculo ejus Dissertationum selectarum, p. 598. & seq. (k) *l. c.* (l) Observat. de Agno Scythico s. fructu Borometz quæ extat in Dissert. sua inaugurali, nec non in Amoenitatum Exoticarum Fasciculo III. Obs. 1.



elegantia, quas describit, & qua ratione ad usus pro vestimentis adornandis Tartaris Persisque familiares præparentur, docet, & addit: “ Magnatum divitumque fastum supra vulgi sortem amiciri cupientem, pullorum pelliculas expetere, qui annosis multo teneriores & eo quidem cariores, quo juniores fuerunt agnelli, quibus detractæ sunt; horum enim pili à pellionibus cogi patiuntur in subtiliores & densiores cirros, qui toti pelliculæ pretium & venustatem tribuunt. Inde fit, ut teneritatis & lucri infidiatores non vereantur ipsam anticipare, crudeli laniena, nativitatem, & matribus uterum gerentibus, dissecto ventre partum ante partum eximere, solius gratia pelliculæ obtinendæ. Hæc rite elaborata, tam dubiam prorsus & delicatissimam teneritatem exhibet, ut resectis extremitatibus, vix agninæ cutis retineat similitudinem, sed ignaram crudelitatem, specie quadam membranæ cucurbitinæ lanuginosæ possit decipere. His subjungit: Pretium pelliculæ, pro bonitatis opinione, exsurgit ad aureos tres, vel amplius; servit ea pro duplicatione mitrarum, nec rarò, ornatus gratia, togarum & amiculorum limbum constituit. Tandem concludit: Sive fabula hæc natales debeat conjecturæ alicujus contemplatoris Philosophi, sive incitæ tribuenda sit primi relatoris, qui per linguæ ignorantiam, vel incuriam, in parergo rem auditam perperam intellexisse potuit, sive cuicunque acceptam referamus occasione alii, qua per longe diffitas regiones passim provecta, ambiguae teneritatis pellicula, integritatem historiæ ac nominis sui amiserit: donec tandem appulsa nobis cum prodigii lepore, in Virum illustrem, curiosum & hujus peregrinæ lanuginis admiratorem incidens, vegetabili vultu suo fidem prodigii, ut solent mirabilia omnia, nullo negotio fecerit. Sic autoritate illustratus error, mox scriptis quoque firmatus, sapientissimorum ingenia & vulgi opinionem ita occupavit, ut hodie pro Zoophyti specie inter rariora Musæorum ostentari soleat, quæ verissima Cæsarei fœtus pellicula est”. Hactenus ille.

Ex citatis patet pelles illas agninas Persicas quæ à Pellionibus nostris **Persianische Baranken** salutantur, hujus esse generis, quamvis non optimæ notæ, illorum scilicet agnorum, qui Cæsarea sectione ex Matrum uteris exscinduntur, cum earum pretium, teste Kæmpfero ad aureos tres, vel amplius in ipsa eorum patria exsurgat, nostræ verò pretio longe minori apud nos, unico scilicet aureo, ad summum veneant.

Interim ante triennium circiter Vir quidam eruditus & curiosus ex Moscovia iter faciens & urbem nostram transiens, Musæolum meum, inter alia quædam Naturalia, Agno ejusmodi, ut vocabat, Scythico, quod pro genuino Borometz, ceu magnum *Κερίμιλλον* venditabat, ditavit. Hic sex pollicum præter propter erat longitudinis, capite cum auribus & quatuor cruribus instructus, coloris ferruginei & totus lanugine quadam instar panni holoserici villosi **Gammet** vulgo



vulgo dicti, tectus, auribus & cruribus, quæ glabra erant, coloris ad fuscum magis vergentis, exceptis. (\*) ad examen vocatum cognovi non esse animalis naturæ, neque fructum alicujus plantæ, sed radicem cujusdam vegetabilis crassam, reptantem & villosam, vel potius caulem scandentem plantæ alicujus qui arte obstetricante figuram aliqualem animalis quadrupedis acquisiverat. Crura enim quatuor erant tot reliquæ caulium, vel si mavis pediculorum abscissorum, qui folia sustentaverant, quemadmodum & aures, qui tamen cornibus similiore; præterea hinc inde emergentes fibræ, per quas more cæterarum nutrimentum radix crassa, vel potius caulis & per hunc planta ceperat, nullum amplius relinquebant dubium. Quartum quoque crus antè, non ut cætera corpori continua, sed arte erat intrusum, quemadmodum & ipsum cum collo caput subtili modo annexum, accuratiori examine deprehendi. Ut adeò hic Agnus eodem artificio ex radice hac vel caule formatus fuerit, quo Homunciones ex Mandragoræ & Bryoniæ radicibus qui ~~Allraunen~~ vulgo dicuntur ab Agyrtis. Remansit mihi tamen dubium, ex qua planta hoc ludibrium artis & naturæ efformatum sit, quanquam mox subiit cogitatio illud plantæ cuidam ex capillarium genere vulgo dicto adscribendum esse, cujus varia habebam indicia, ab analogia mihi cognitarum quarundam exoticarum specierum, nonnullarumque ab Illustri D<sup>o</sup> Hans Sloane & Rev. P. Carolo Plumier in splendidissimis suis Operibus descriptarum & delineatarum; utpote, quarum diversæ caules scandentes ejusmodi lanugine ferruginea s. rufescente musco, ut vocant, tectos emittunt. Interim tamen, ex qua specie præcise, determinare non volui, Peculiarem itaque forte nondum descriptam speciem esse, quæ in Tartaria reperitur, arbitror, donec cum tempore certiora edoctus fuero.

Hanc meam sententiam confirmant, quæ postmodum legi in Transactionibus Philosophicis Anglicanis (m) ubi Illustris Ds. Hans Sloane, similem Agnum Scythicum fictum ex India Orientali nactus descripsit & delineavit, qui tamen longe minus Agni figuram refert, quàm meus memoratus.

Credo autem ejusmodi Agnos ex certis radicibus vel caulibus in Moscovia & Tartaria effingi, ut aliquo modo Historiæ Agni Scythici Vegetabilis adstruatur Veritas. Quis autem non videt hunc ab eo, qui a supra citatis Authoribus describitur, plane diversum, nec tanta admiratione dignum esse, cum etiam hic ex variis radicibus varia portenta, quæ rerum naturalium quarundam similitudinem aliqualem habeant, effingi possint; quemadmodum supra de Mandragoræ radicibus retuli dum interim hic non magis agnus dicendus, sed

(\*) Vid. Figuram natura dimensione expressam. (m) N<sup>o</sup> 287. p. 861. quod etiam reperitur in the *Philosophical Transactions* abridged by John Lowthorp, Vol. 2. p. 646. f. 160.



radix vel caulis revera est & manet plantæ cujusdam, ac Homunciones *Allraunen*, Belgice *Pisse Diefjes* (n) dicti, radices *Mandragoræ*.

IV. 1. The first and best Sort of Cinnamon, which grows in great Plenty in *Ceylon*, and is peculiar to that Island, is called by the Natives *Rasse Coronde*, that is, sharp, sweet Cinnamon. 'Tis this choice Sort, which is exported yearly by the *Dutch East-India-Company*, by whom it hath been prohibited under severe Penalties, that no other Sort should be mixed with it.

*An Account of the Cinnamon Tree in Ceylon, and it's several Sorts. Communicated by the Chief Inspector of the Cinnamon Trade and Manufacture in that Island to Mr Albertus Seba, at Amsterdam. Translated by the late Dr Scheuchzer, F. R. S. No. 409. p. 97.*

The second Sort is called *Canatte Coronde*, that is, bitter and adstringent Cinnamon; for the *Ceylonefe*, in their Language, call Cinnamon in general *Coronde*, and *Canatte* signifies bitter and adstringent. The Bark of this Tree comes off very easily, and smells very agreeably when fresh, but hath a bitter Taste. It is an Advantage to us, that it doth not grow in great Plenty hereabouts, because one might easily mistake it for a better; as indeed, in general, it requires a good deal of Skill and Attention so to distinguish the Cinnamon Trees from each other, as not to choose now and then a worse Sort for the best. The Root of this second Tree yields a very good sort of Camphire.

The third Sort is called *Capperoe Coronde*, that is Camphorated Cinnamon, because it hath a very strong Smell and Taste of Camphire. It grows plentifully enough in the Island, but not in the Eastern Parts of it: However, they find Means now and then to send it over privately, and sell it to the *Danes* and *English*, who come to Trade upon the Coasts of *Cormandel*; for as long as there is but one Port in the Island left open, abundance of this sort of bad Merchandize may be exported. Besides, there is sort of a *Canella*, on the Continent of *India*, about *Goa*, which is very like this sort of Cinnamon Tree, though it hath nothing of the true Cinnamon. The same sort of *Canella* agrees in many Things with the *Canella Malabarica Sylvestris*, a wild Cinnamon Tree, growing upon the Coasts of *Malabar*. And although with regard to the Shape of the Tree, and the outward Appearance of the Bark and Leaves, there is very little Difference to be observed between these two sorts of *Canella*, and the best sort of Cinnamon, yet the latter is vastly superior in Richness, Virtue, and Sweetness.

The fourth Sort, called *Welle Coronde*, that is, the *Sandy Cinnamon*, because upon chewing it, one feels as it were, Bits of Sand between the Teeth, though in Fact there is nothing sandy in it. The Bark of this Tree comes off easily enough, but is not so easily rolled up into a fibular Form, as other sorts of Cinnamon are, being apt to

(n) De quibus vid. Deusingius de *Mandragoræ Mangoniis*, quod extat in ejusdam Fasciculo *Dissertationum*, p. 586. nec non *Miscellan. Natur. Curios.* D. 1. A. 1. Obs. 48.



burst open and unfold itself. It is of a sharp and bitterish Taste and the Root of it yields but a small Quantity of Camphire.

The fifth Sort is called *Sewel-Coronde*, *Sewel* in the *Ceylonefe* Language signifies mucilaginous, or glutinous. This sort acquires, in drying, a very considerable Degree of Hardness, which upon chewing of it sufficiently shews itself. It hath otherwise but little Taste, and an ungrateful Smell; but the Colour of it is very fine, and it is not many Years since I first took Notice, that the Natives, who are all Blacks, mix a good deal of this mucilaginous Cinnamon with the best Sort, the Colour of both being very much alike, excepting only, that in the good Sort there appear a few yellowish Spots towards the Extremities.

The sixth Sort is called *Nieke Coronde*, the Tree which bears it, having a good deal of Resemblance to another Tree, which is by them called *Nieke Gas*, and the Fruit it bears *Nieke*. The Bark of this sort, hath no manner of Taste or Smell, when taken off, and is used by the Natives only in Physic. For by roasting of it they obtain a Water and Oil, which they anoint themselves withal, thinking thereby to keep off all sorts of noxious Fumes, and Infections in the Air. They likewise express a Juice out of the Leaves of it, which they say cools and strengthens the Brain, if the Head be rubbed with it.

The seventh Sort is called *Dawel-Coronde*, that is, Drum-Cinnamon, in *Low Dutch Trommel-Caneel*: The Reason of this Appellation is, because the Wood of this Tree, when it is grown hard enough, is light and tough, and that Sort, of which the Natives make some of their Vessels and Drums, which they call *Dawel*. The Bark is taken off, when the Tree is yet growing, and is of a pale Colour: The Natives use it in the same Manner with the sixth Sort.

The eighth Sort is called *Catte-Coronde*, that is, the thorny or prickly Cinnamon; *Catte*, in the *Ceylonefe* Language, signifying a Thorn, or Prickle; for this Tree is very prickly. The Bark is in some Measure like Cinnamon, but the Leaves differ very much, and the Bark itself hath nothing either of the Taste or Smell of Cinnamon. The Natives use the Root, Bark and Leaves of this Tree in Physic, applying them in Form of Cataplasms, to Tumours and Swellings from a thick corrupt Blood, which they say it cures in a short Time.

The ninth Sort is called *Mael Coronde*, or the Flowering Cinnamon, because this Tree is always in Blossom. The Flowers come nearest to those of the first Sort, but they bear no Fruit, which the other doth. The Substance of the Wood becomes never so solid and weighty in this, as in the other Cinnamon Trees above-mentioned, which have sometimes eight, nine, or ten Feet in Circumference. If this everflowering Cinnamon Tree be cut, or bored, a limpid  
Water



Water will issue out of the Wound, as it doth out of the *European Birch-Tree*, but it is of no Use, any more than the Leaves and Bark.

The Inhabitants of *Ceylon* say, there is still another Sort of Cinnamon, which they call *Toupat Coronde*, or the three Leaved Cinnamon. It doth not grow in that Part of the Country which the *Dutch East India Company* is possessed of, but higher up towards *Candia*. Having never seen it myself, I will also, out of regard to Truth, say nothing farther of it.

All the several sorts of Cinnamon Trees, the best as well as the rest, must grow a certain Number of Years, before the Bark is fit to be taken off: With this Difference however, that some of the Trees of the same sort, as for Instance of the first and best, will ripen two or three Years sooner than others, which is owing to the Difference of the Soil they grow in; those for Instance, which grow in Vallies, where the Ground is a fine whitish Sand (and there are many such Vallies in the Island of *Ceylon*) will in five Years Time be ready, whereas those, which stand in a wet slimy Soil, must have seven or eight Years Time to grow, before they are ripe enough. Again, those Trees are later, which grow in the Shade of other larger Trees, whereby the Sun is kept from their Roots: And hence also it is, that the Bark of such Trees hath not that Sweetness and agreeable Taste observable in the Bark of those Trees which grow in a white Sandy Ground, where with little Wet they stand full exposed to the Sun, but is rather of a bitterish Taste, something adstringent, and smells like Camphire.

For by the Heat of the Sun's Rays the Camphire is made so thin and volatile, that it rises up and mixes with the Juices of the Tree, where it undergoes a small Fermentation, and then rising still higher between the Substance of the Wood, and the thin inner Membrane of the Bark, it is at last so effectually diffused through the Branches and Leaves, that there is not the least Footstep of it to be perceived any where. Mean while that thin and glutinous Membrane, which lines the Bark on the Inside between it and the Substance of the Wood, attracts and sucks in all the purest, sweetest, and most agreeable Particles of the Juice, leaving the thick and gross ones, which are pushed forward, and serve to nourish the Branches, Leaves, and Fruit.

What I here mention, is from my own Observations, and I have often had Occasion to prove this Fact to curious Persons by the Things themselves. For if the Bark be fresh taken off, that Juice which remains in the Tree hath a bitterish Taste, not unlike that of Cloves. On the contrary, if you taste the inner Membrane of the Bark, when fresh taken off, you will find it most exquisitely sweet, and extreamly agreeable to the Taste; whereas the outward Part of



the Bark differs but very little in Taste from the common Trees; which shews plainly that all the Sweetness of it is owing only to the inner Membrane. But when the Bark is laid in the Sun in order to be dried and wound up, this oily and agreeable Sweetness of the inner Membrane diffuses itself throughout the whole outward Part of it (which however hath been first stripped, whilst yet upon the Tree, of it's outermost greenish Coat) and imbues it so strongly, as to make the Bark a Commodity, which for the Fragrancy of it's Smell, and the Sweetness of it's Taste, is coveted all over the World.

The Bark may be taken off from Trees which have stood fourteen, fifteen, or sixteen Years, after they are come to Maturity, according to the Quality of the Soil they stand in: But after that Time they lose, by Degrees, their Taste and agreeable Sweetness, which makes the Bark have more of the Taste of Camphire: Besides, the Bark is then grown so thick, that if it be laid in the Sun, it will no longer shrink and wind it self up, but remain flat.

And here it may be thought a fit Subject of Enquiry, how it comes to pass, that, considering what vast Quantities of Cinnamon have been exported from this Island, and sold all over the World, there are yet such Numbers of good Trees fit to be barked, remaining in the Island and growing there every Year? Now in order to solve this Question, several Authors, who described the Island of *Ceylon*, committed a considerable Mistake, when they assured their Readers, that when the Bark hath been stripped off the Tree, it grows again in four or five Years, and becomes fit to be stripped a second Time. But this Assertion is entirely contrary to the Course of Nature and Observation: Nor do I believe that there is any one Tree whatever in any Part of the World, which, if it was entirely stripped of it's Bark, could subsist and grow any longer: That Part at least, where the Bark hath been taken off, will quickly grow dry, and so die away; but the Root in the mean while remains entire and in good Condition; and this shews the Reason why there is such a Number of Trees fit to be barked every Year. For although the Cinnamon Trees, after the Bark hath been once taken off, is cut down to the very Root, as they do in *Europe* Oaks, Birch-Trees, Alders and Willows, yet the Root will quickly push forth new Shoots, which will ripen in a short Time, I mean in five, six, seven or eight Years, some sooner, some later, and then yield their Quantity of the Bark. Hence it appears, how far the old Roots are instrumental to the Growth and Plenty of Cinnamon Trees, but the Fruit which falls from the Trees, contributes very much towards the same End: And it is particularly owing to a certain kind of wild Doves, which from their feeding on the Fruit of the Cinnamon-Tree, they call *Cinnamon-eaters*, that these Trees grow so plentifully



in this Island; for the Doves, when they fetch Food for their young ones, flying here and there, disperse vast Quantities of the Fruit all over the Fields, which occasions the Rise of many thousand young Trees, which may be seen along the Roads in such Quantities together, that they look like a little Wood.

The Oil drawn out of it by Fire is reckoned one of the strongest Cordial Medicines: The Camphire which comes out of the Root, is likewise of great Use in several Distempers, as are also the Oil of Camphire, a very costly Thing, the Leaves of the Tree, and the Oil distilled out of them; and lastly, the Fruits with their Oil. In short, there is no Part of the Cinnamon Tree, but what is of some singular Use in Physic. I purposely avoid speaking of the large Gains the Company makes by the yearly Export of this precious Commodity.

2. Having some Years ago bought out of the *East-India* Company's Warehouses at *Amsterdam*, a considerable Quantity of Cinnamon Leaves, or *Folia Malabathri*, packed up in several large Chests, I happened to find in one of them the Flowers of the Cinnamon, as big as the *Italian* Bean-flowers, and of a blue Colour; I chanced likewise to meet with the Fruit. But I could not find either in any of the other Chests.

*Additions to  
the foregoing  
Account, by  
the same.  
No. 419. p.  
106.*

In 1722 and 1723, I bought of the same Company the Oil, which is expressed out of the Fruit of the Cinnamon Tree, as also that which is boiled out of them, which is of a very good Consistence and white, and is by the *East-India* Company called Cinnamon Wax, because the King of *Candia* causes Candles to be made out of it, which for their agreeable Scent, are burnt only by himself and at his Court. However he permits his Subjects to express the Juice out of another Fruit, not unlike the Fruit of the Cinnamon Tree; but this being only a thin fat Substance, like Oil of Olives, they cannot burn it any otherwise than in Lamps.

The *Indians* use this Cinnamon Wax also in Physic, and give it inwardly in Luxations, Fractures, Falls, Contusions and Bruises, that in case any inward Part be touched or bruised, it may by it's Balsamic Virtues heal them. They give it also in Bloody Fluxes to one Dram or a Dram and a half. Outwardly applied, it makes the Skin more beautiful, smoother and softer, than any one known sort of Pomade.

The Leaves of the Cinnamon Tree yield also an Oil, which is of a bitterish Taste, resembling Oil of Cloves mixed with a little good Oil of Cinnamon. It is called *Oleum Malabathri*, or Oil of Cinnamon Leaves. It is an Aromatic, and is reckoned an excellent Remedy in Headaches, Pains of the Stomach, and other Distempers.

The Oil of the Root of the Cinnamon Tree is, properly speaking, an Oil of Camphire, the Roots affording a good Quantity of Camphire. About two Years ago, I bought a Bottle of it of our *East-India* Company. There were several Bottles together in a Box, upon which was written



written in Low Dutch *Dese Oliteyten syn tot een geschenk nyt Candia geschikt*; that is, *these Oils were sent as a Present out of Candia*, which shews that they are genuine, without any Adulteration; If this Oil be distilled in Glass Vessels, there comes over along with it, that sort of Camphire which the *Indians* call *Camphire Baros*, or Camphire of *Borneo*, which shoots in thin transparent Crytals, forming a beautiful Variety of Trees on the Recipient, not unlike those, which in very frosty Weather are to be seen upon Windows. This sort of Camphire is of very great Efficacy in Physic, and is gathered and kept for the King of *Candia's* own Use, who esteems it an excellent Cordial. But not only the Camphire of *Baros*, but also the Oil of Camphire, which is drawn out of the Roots of the Cinnamon Tree, is a very great Cordial, if taken inwardly: It strengthens the Stomach, expels Wind, and hath been found of great Use in arthritic and gouty Disorders: It is also a Diuretic. The Dose is ten or twelve Drops upon a bit of Sugar, or in a proper Vehicle. Outwardly it is applied in all arthritic Pains from Cold and Obstructions, being rubbed on the affected Part with a warm Hand, and it will presently lessen the Pain, and by Degrees take it off. About six and thirty Years ago Mr *Nicolas Dumbstdorff* at *Amsterdam*, was so cruelly afflicted with arthritic Pains, that he could have no Rest neither Night nor Day; and although he called in the Assistance of several noted Physicians, and tried abundance of Medicines, yet he could find no Relief, till he was advised to cause himself to be anointed with the Oil of the Root of the Cinnamon Tree; of which he then happened to have a good Quantity by him. I anointed him myself, rubbing the Oil on all the affected Parts with my Hand warmed by holding it to an Oven, and this I did twice every Day for an Hour together. And though, when this Cure was first begun with him, his Hands and Feet were by the Convulsions and the Violence of his Pain, so contracted, that they grew quite crooked, and were full of Nodes, yet in a Fortnight's Time he grew so much better, that he could sleep well at Nights, feeling neither Pains nor Cramps. In about six Weeks Time he could walk about his Room, whereas before the Anointing he was not able to stir either Hand or Foot. This Anointing was continued for about three Months, when the Patient not only recovered of that violent Indisposition, but continued free from the Gout ever after, and lived about fifteen Years in very good State of Health. And I can not only affirm this to be true of my own certain Knowledge; but also, that since that Time I have advised several People in his Condition to do the same with as good Success. Several Physicians have written largely of the Virtues of common Camphire, but there are as yet many hidden Qualities in this excellent Medicine. Thus, for Instance, I can affirm, that in all Burnings, by Fire or otherwise, and the Pains occasioned thereby, I have



I have not yet met with any better and surer Medicine than this following;

℞. Spir. Lumbricor. terrestr. cum Spir. Vini  
rectificat. ℥xij. Camphor. ℥ji. M.

No sooner is a Bandage, or Compress, dipped into this Spirit applied to the affected Part, but it will give instant Relief, and so effectually check the Inflammation, that it will creep no farther. But the Application of it must be continued till the Pain is quite gone, and the *Ulcus*, if there hath been any, is dried up. If the Exulceration is got deeper, and the Wound must be kept open, two Ounces of Camphire dissolved in *Oleum Hyperici*, mixed with a Pound of the common *Unguentum Cerussæ*, applied according to Art, will quickly and effectually heal it, as I have often experienced.

V. The first general Division of these Roots must be, into true and false; and each of these may be again subdivided into several Species, the distinctive Note of which is principally taken from their Colour.

*Of the different Kinds of Ipecacuanha,*  
by James Douglas.  
M. D. F. R. S.  
No. 410,  
pag. 152.

Of the true *Ipecacuanha* I have four Kinds, Black, Brown, Grey, and White; but I cannot pretend to determine whether they belong to different Plants, or are only Varieties of the same Plant owing to the Soil in which they grow, as is affirmed by Sir *Hans Sloane*. And as these Roots are never imported to us entire, it is impossible to give any certain Description of them in that State.

However, by comparing the several dried Pieces as we have them, we may very probably conjecture that a short radical Trunk descends from a *Caulis*, and is afterwards divided into several large Branches, and these again into smaller ones, in different Series, with minute Filaments, or Fibrillæ, going out from them.

Each Piece is made up of an Outer or Cortical part, and an Inner or Fibrous one, which like a white Nerve, or smooth compact Fasciculus of woody Filaments runs through the Center or Axis of the Roots, and perhaps encloses within it a small Pith, which however is hardly discernible by the naked Eye.

The Cortical Part is corrugated by two Sorts of Wrinkles, one superficial, consisting either in circular Rings or little Knots which do not go quite round; the other penetrating into it's Substance, being deep Incisures or Fissures reaching all the Way to the Nerve.

What Lengths these Roots are of when taken out of the Ground, cannot be determined: I have met with some Pieces above nine Inches, many above six, but the greatest Number are still shorter.

We



## Of the different Kinds of *Ipecacuanha*.

We find them bent, wreathed, and contorted into all Manner of Figures; and indeed few Pieces are altogether straight for any considerable Length.

What has been hitherto said, agrees to all the true *Ipecacuanha*-roots; but several other Things are still to be taken Notice of, in which they differ.

The Black Sort is the smallest of the four, very hard, and the Fissures wide and numerous. The outward Colour of the Cortex is not equally black in all the Pieces of this Kind, and it's inner Substance, as well as the Nerve, is mostly white, tho' not always in the same Degree.

The Brown Sort is larger than the Black, the Fissures at larger Distances, the inner Substance of the Cortex darker, and the external Colour has several Degrees of Redness in the several Pieces.

The Third or Grey Sort is sometimes found of a darker, sometimes of a lighter Colour, and the Inner Substance of the Cortex is Brown streaked with White. It is much larger than the black Sort, many Pieces being above  $\frac{1}{4}$  of an Inch in Diameter, but the Nerve is smaller in Proportion to the Cortical Part. I have met with few Pieces of this Species above five Inches in Length; but, as I already observed, nothing can be concluded from thence as to the Length of the whole Roots. The Fissures are here still fewer than in the brown Sort, and in some Pieces scarce any are to be met with. The superficial Corrugations are various in different Roots, some being almost wholly smooth, and in others the Wrinkles rather longitudinal than circular.

The white Kind, as far as I can judge by the small Sample which I have of it, is of very different Sizes, some Pieces of it being larger than any of the grey Sort, and the rest much less. The whitish Colour of the Cortex has a yellowish Cast, and the nervous Part is very large in Proportion to the rest. Very few Fissures are to be observed therein, and hardly any reach so deep as the Nerve. The other Corrugations are likewise very shallow, and most of them longitudinal; but it seems to be more knotty than the other Kinds, and these Knots I take to be owing chiefly to the *Fibrillæ* which go out from the larger Branches of the Roots.

The Places of Growth of these different Species of *Ipecacuanha* have not as yet been fully settled.

The Black Sort is hitherto known to come only from *Brasil*, by the Way of *Lisbon*, and some of our Druggists for that Reason distinguish it by the Name of the *Brasil* Root.

About the Brown Sort, I am informed by Dr *James Houston*, who resided for several Years in *New-Spain*, that it grows plentifully at some Distance from the City of *Cartagena* in the Kingdom of *New Granada*; from whence it is frequently sent in Saroons or Skins, containing



containing 100 Weight, to *Jamaica*, and so to *England*; where it is certain we have had it of late Years in great Abundance.

The Grey *Ipecacuanha* is with us preferred to all the rest, and by far the most generally used when it can be had. It is said by Authors to grow in *Peru*, from whence, it is brought to *Porto-Bello*, and from thence into *Europe*, by the *Spanish Galleons*. Some Parcels thereof are likewise probably sent from *Porto-Bello* to *Jamaica*; for we are certain that it has sometimes been imported hither from that Island. By some Specimens that were brought me, from *St Thomé*, a *Portuguese* Island under the Equinoctial, whither they were sent directly from *Brazil*; it is evident that this Species is likewise a Native of that Country, and therefore must either have been included by *Piso* under one of the two Species mentioned by him, or else discovered since his Time. According to Father *La Bat*, in his late Voyage to the Islands of *America*, this Species grows also plentifully in *Martinico*, where for many Years past it has been used by the Inhabitants.

The White Sort, called by the *Portuguese*, *Ipecacuanha Blanca*, is said by *Piso* to grow in *Brazil*, and if we may believe Father *La Bat*, it is likewise found in *Martinico*.

These are the four Kinds of true *Ipecacuanha* which have hitherto come to my Knowledge; but I have met with two other Roots to which that Name has been falsely ascribed, which from their outward Colour I shall call White and Reddish Brown.

The White Sort agrees pretty much both in Colour and Surface with the true White, but it is not near so knotty. It is likewise considerably larger in Size, straighter and softer to the Touch.

The Brown Sort is of a deeper Colour than the true Brown, and many Pieces thereof have some Mixture of Red (from whence it has been sometimes called Red *Ipecacuanha*) and the inner Substance of the Cortex inclines to a reddish Yellow. The Pieces thereof are much longer than any of the former Sorts, some of them measuring sixteen Inches, and they are of a Size between the Black and Grey. The Fissures are at greater Distances from one another than in the true Brown, and the Spaces between them much smoother. In a Word, though this Root when mixed with the true Brown, to which it bears the greatest Resemblance, may easily be confounded therewith; yet when they are attentively compared, their whole Appearance sufficiently distinguishes them.

Both these false Kinds were brought me from *Maryland* in 1725, by a Surgeon, who informed me that they grow there in great Plenty, being called *Ipecacuanha* by the Inhabitants, and used as a Vomit by those of inferior Rank. I have since that Time received a Sample of the Brown Sort, taken from a Parcel which lay in the Custom-house, above twelve Years ago, and called by the Name of wild *Ipecacuanha*.



## A Description of the *Cereus Peruvianus*.

Sir *Hans Sloane* informed me that this false Brown Kind was the same that was formerly sent to him from *Virginia* for the true *Ipecacuanha*, and which he afterwards discovered to be the Root of a poisonous *Apocynum* described by him in his *Natural History of Jamaica*; in which Island it is very common, and likewise in *New-Spain*, as appeared by the Specimens sent him by Dr *Burnet*.

*A Description of the Cereus Peruvianus, which flowered at Norimberg in 1730, by Dr Christopher James Trew. F. R. S. Translated from the Latin by T. Stack, M. D. No. 416. p. 462.*

VI. This *Cereus*, is six Foot three Inches high, and thirteen Inches thick. It has seven Angles at it's Basis, eight about the Middle, and nine near the Top. It's upper Part is of a Sea-Green, from the Powder with which it is covered; it's lower of a Grass Green. The Down of it's Prickles is between Pale and White about the Top, every where else it is Brown. Sept. 5, at the Height of six Foot two Inches from the Ground, it shot a round Knot from it's Trunk, which so encreased and extended almost horizontally, that on the fourteenth of the same Month, it was eight Inches long, and plainly shewed a Flower, though as yet closed, embellished with a beautiful Mixture of Green, Purple, and White. The same Evening the Flower began to open, and continued till Midnight; when being entirely spread, it was six Inches in Diameter. It was of a pretty strong, but not very pleasant, Smell. After Midnight it gradually contracted about half an Inch, and remained thus till next Day at Noon. Then it began to contract faster, to half the Diameter of the expanded Flower; and the next Morning it was quite closed and withered, but hung on the Trunk till Sept. 30. The Beginning of the Flower was a Tube three Inches long, not quite an Inch thick, between a yellow and a pale Green. It's Surface was channelled with small narrow Furrows, between which, blunt Protuberances were seen to run, in a parallel Order, along the Ridges. Where the Tube expanded itself, it divided into more than forty petaloid Segments, ranked in six separate Series, the three inferior and exterior whereof here and there confounded their order, while the three superior and interior remained regular and unmixed. These Series were distinguished by their Size and Colour. The first, or exterior, was of the same Colour with the Tube, viz. of a pale Green; but it's upper Part gradually inclined to a Purple. The second and third had half the inner Part greenish, the Edges of a more intense Purple. The fourth was between yellow and white, terminating in purple Tops. The Tops of the fifth were likewise purplish. The petaloid Segments of the sixth were very tender and white. The Segments are of an oblong Figure, and in the first Series were terminated with blunt, in the others, with more and more pointed Tops. The inner or sixth Series, which contained thirteen of these Segments, exhibited all the Edges finely and lightly, but irregularly cut and divided. The *Pistillum* of equal Height with the Surface of the Flower, and hollow like a small Tube, ran, at it's upper End, into as many fine pale Filaments, spread in the Form of a Crown, as there were Segments in the



the inmost Row, the Day before the Flower dropped from the *Ovarium*, the Place where it was to separate was marked by a blackish Circle, at which the Tube separated spontaneously from the *Ovarium* or *Matrix*, that is, the Rudiments of the Fruit; the *Pistillum* still firmly adhering to the *Ovarium*. The Flower now fallen, being dissected longitudinally, the Origin of the *Stamina* lay open to the Eye; and it very manifestly appeared that the petaloid Segments of the Flower far from affording the least Mark of a natural Partition, stuck so very close to the Tube, that not one of them would quit it without tearing it off by Violence.

The Fruit, though it came not to it's full Growth, plainly evinced, by Inspection alone, that it is not prickly. Upon Dissection it afforded a viscous Juice, and within was a Cavity, the Sides whereof were every where, except at the Bottom, thick set with an innumerable Quantity of small *Villi*, to each one of which hung an oblong white, pellucid Vesicle, which is the Rudiment of the future Seed.

VII. *Contrayerva* is a Spanish Word, signifying as much as *Herba contra [Venena]* or a Herb against Poisons. And as there are in all Countries different Plants to which that Virtue is ascribed, the Name of *Contrayerva* seems to have been given by the Spaniards to as many of them as have come under their Knowledge; for *Hernandez* has described a Species of *Granadilla* by that Name, and there are several other Roots that are commonly known by it: But far from pretending to give a History of all those Roots, I only offer a short Account of that Plant whose Root is called *Contrayerva* here in *England*, and is so well known to all that any way deal in Medicines.

An Account of  
the Contrayerva,  
by William  
Houltoun,  
M. D. No.  
421. p. 195.

The Root itself being so commonly known it would be superfluous to describe it, I shall therefore confine myself to the Description of the Plant that produces it, which I have not hitherto met with to my Satisfaction in any Author.

Father *Plumier*, in his Book entituled, *Nova Plantarum Americanarum Genera*, describes a Genus which he calls *Dorstenia*, whereof I have found two Species in the *West-Indies*, the Roots of which are gathered and exported indifferently, as being very much alike, both in Appearance and Virtues. One of these I think may be called.

*Dorstenia Dentariæ radice, Sphondylii folio, placenta ovali.* And the Fig 103.  
other

*Dorstenia Dentariæ radice, folio minus laciniato, placenta quadrangula-ri & undulata,* Fig 109.

The first Kind seems to be the *Tuzpalli* of *Hernandez*, pag. 147. It's Roots, which are perennial, put forth in the Month of *May* (or as soon as it happens to rain) each six or eight Leaves four or five



*An Account of the Contrayerva.*

Inches long, and as many broad, cut into several Segments almost as deep as the middle Rib, somewhat after the Manner of the *Spondylium*: They stand upon Footstalks five or six Inches long; and from the Middle of them come forth other Footstalks somewhat longer, sustaining each a strange Sort of Body, flat, and situated vertically, or with one Edge uppermost, which I have called *Placenta*. In this Species it is of an oval Figure, with it's longer Axis parallel to the Footstalk. One side of it is smooth and green like the outside of the *Calix* in other Plants; but from the other arise a great many small yellow Apices; and after they are gone, many small roundish Seeds begin to appear, which when ripe are somewhat like those of *Gromwell* or *Lithospermon*. It grows in the Kingdom of *New-Spain*, near old *Vera Cruz*, on the high Ground, by the Side of the River.

The second Kind has much the same Number of Leaves growing from each Root, as the former; but of a different Figure, for some of them are entire, and shaped like those of a *Violet*, others angular like *Ivy*, and some almost as much divided as the Leaves of the common *Maple*. They are thin, and of a dark green Colour, and smooth, or have only a few scarce perceptible Hairs on the Back. The Pedicles that sustain the Flowers arise immediately from the Root as in the other Species, and attain to the same Height of six or eight Inches. But the *Placenta* which sustains the Flowers, is in this Kind quadrangular, waved about the Edges, and broader transversely than vertically. Yet the Flowers and Seeds themselves are perfectly the same as in the other. This second Kind grows plentifully on the high rocky Grounds about *Campechy*, where I gathered it in Perfection in the Beginning of *November*, 1730.

I cannot guess why Father *Plumier* has called this a monopetalous Plant; for that which he calls the *Petalum*, and I the *Placenta*, is of a green Colour, and (which is of more Consequence) sustains the Seeds when ripe, and never envelops the Organs of Generation when young; so that I think it can by no Means be called a *Petalum*, nor even properly a *Calix* and therefore I have given it the Name of *Placenta*, whose Office it certainly performs.

I have not been able to observe exactly the Structure of the Organs of Generation, because of their excessive Smalness; but they appear to the naked Eye as they are represented in the Figures I have given of them, and in *Plum. N. G. Tab. 8.* The *Dorstenia Spondylii folio Dentariæ radice*, of *Plumier*, differs from both of mine; for in his Drawings done by Order of the late King of *France*, whereof I have seen a Copy in the Collection of the late Dr *Sherard*, the Leaves are represented serrated, the *Placenta* quadrangular, and the Roots consisting of several Knobs tied together Lengthways. From which last Particular, I am persuaded that the Root of that Species is the *Drakena Radix*, mentioned by *Clusius* in his *Exotics*, pag. 83.





*Fig. 107*



*Fig. 108.*







VIII. 1. In my Way thither, I took Notice of the following Plants which I have not observed to be common in other Parts of England, and are not taken Notice of by the Bishop of London, in his Edition of *Cambden*.

*Stachys Fuchsi*, J. B. in the Road to *Grantham*, a little beyond *Coleworth*.

*Rare Plants in a Journey to the Peak in Derbyshire; by John Martyn F. R. S. No. 407. pag. 22.*

*Scrophularia Scorodoniæ*, folio Mor. At *Wollerton*, under the Garden-wall. This does not owe it's Origine in this Place to Seeds, scattered out of the Garden; as I am convinced, by the perusal of a Manuscript Catalogue of the Plants cultivated in that Garden, in which there is no mention made of this Plant.

The *Lychnis*, which grows on *Nottingham-Castle*, is the *Lychnis sylvestris alba* 9 *Clusii*, and not the same with Mr Ray's *Lychnis major noctiflora Dubrensis perennis*, as he suspected.

*Festuca humilior panicula brevi heteromalla*. *Gramen paniculatum, bromoides, minus, paniculis aristatis, unam partem spectantibus Raii Syn.* On *Sherwood Forest*.

*Salix folio laureo, seu lato glabro odorato Phyt. Brit.* Common about *Wingerworth*.

*Ladanum arvense, flore amplo luteo; labro purpureo*. *Lamium cannabinum, flore amplo luteo, labio purpureo Raii Syn.* In the Corn in several Places.

*Filix mas non ramosa, pinnulis angustis, raris, profunde dentatis Ger. emac.* Common about *Wingerworth*.

2. The more rare Plants which I observed in the Peak are,

*Scariola sylvestris Anguillaræ*. *Lactuca sylv. murorum flore luteo J. B.* On old Walls, and about the Entrance into *Peak's-hole*. It grows also in *Hertfordshire*. I choose to take Notice of it on this Occasion, the rather because *M. Vaillant* has evidently mistaken the Characters of it in his new Distribution of the *Cichoraceous Tribe* in the *Memoirs of the Royal Academy of Sciences* for the Year 1721. He there makes it a Species of *Lactuca*, from which it is very different on his own Principles. According to his Method, the Empalement of the *Lactuca* is squamous, and the Down of the Seed sits upon a Pedicle. But this Species has a simple Empalement and a sessile Down. These Characters evidently distinguish it not only from *Lactuca*, but from every Genus in his Method. I shall take leave therefore to constitute a new Genus: And as the Name of *Scariola*, by which *Anguillara* has called it, has not yet been appropriated to any other Genus, I shall appropriate it to this, and define it, as follows.

*Scariola* is a *Cichoraceous Plant*, with a simple Empalement, a naked Placenta, and Seeds crowned with a hairy sessile Down.

*Rosa sylv. alba cum aliquo rubore foliis hirsutis J. B.* In several Hedges about *Hathersedge*.

*Empetrum montanum fructu nigro Tourn.* Common on the Mountains,

*Oxycoccus,*



# Rare Plants in a Journey to the Peak in Derbyshire.

*Oxycoccus*, seu *Vaccinia palustris*, J. B. On boggy Places, but not very common.

*Erica humilis cortice cinereo Arbuti flore albo*, H. R. Par. On the Mountains near *Hathersedge*.

*Rubus Idæus spinosus fructu rubro*, J. B. In the Hedges.

*Geranium saxatile Ger. emac.* About the Entrance into *Peak's-hole*.

*Cochlearia rotundifolia minima Merr.* With the preceeding.

*Thalictrum minus Ger.* In the same Place.

*Lichenoides saxatile, fuscum, pilosum, varie divisum. Corallina fusca foliosa Doody Budd. Hort. sicc.* On the Rocks.

*Lichenoides saxatile tinctorium foliis pilosis purpureis Dillenii.* On the Rocks.

*Usnea saxatilis, capillacea. Muscus corallinus, saxatilis, fœniculaceus Raii Syn.* On the Rocks near *Darwent*.

*Lycopodium Sabinæ facie Fl. Jen.* On the Mountains near *Darwent*.

*Selago foliis & facie Abietis Fl. Jen.* On the Mountains near *Darwent*.

*Bryum Hypnoides capitulis, plurimis erectis lanuginosum Dillenii.* On the Mountains.

*Cardamine impatiens altera hirsutior Raii Syn.* About the Mouth of *Pool's-hole* plentifully.

A Variety of Mr Ray's *Viola montana lutea* with a blue and yellow Flower.

Observations  
upon the Seeds  
of Plants.  
By Mr Lew-  
wenhoek,  
translated by  
John Cham-  
berlayne, Esq;  
No. 368. P.  
200.

IX. I have often turned my Thoughts to the observing the so called Membranes, in which the Substance of Meal, or Flower, is inclosed, like little Packets in Cells or Boxes, which is also the case of all kinds of Beans, Pease, Wheat, Barley and other Grain. I at length, with Astonishment, discovered very plainly, that what I call the Membranes, were endued with an unspeakable number of little Holes, thro' which, in many places, one might perceive the Light; which Holes we must suppose to be nothing else but little Vessels, which had been torn or cut off, and partly compose the Membranes, which I call little Cells, and partly serve for the Production of the *Farina*, of which there are an infinite number of Particles in a Pea or Bean, I imagine that each of those mealy Particles receives it's increase from a little Vessel, which proceeds from the Cell; and is imperceptible through it's Smallness.

These Vessels, of which the little Cells, or Cases mostly consist, are more easy to be discovered in Beans and Pease, than in any sort of Legumens or Grains; but in Wheat the Vessels are difficultly traced in the Cells, and I have been obliged to make very many Observations and Experiments, before I could fully satisfy myself, that I saw the torn or broken Vessels; the Reason of which is, that the little Vessels, of which the Cells or Skins of the Grains of Wheat are composed, are exceeding thin and brittle.

More-



Moreover, I have found, upon observing the Vessels, of which the Cells are composed, that several of the Globules in Wheat were broken in pieces in the Operation, and that in one of those single Globules, there were other small Globules enclosed.

I have likewise observed that the Membranes, or little Cells, in *Barley*, in which the Globules, or Parcels, of the Meal are shut up, and receive their increase, are thicker and stronger than those of *Wheat*.

Although I conclude, that almost all Seeds and Grains, as well as their Membranes, or Skins, are of one and the same Texture and Configuration, yet for Experiment sake, I took a large *Almond*, and cut off several thin Slices from it, and dug out of those Slices, as well as I could, the Substance that lay in the little Cells, and viewing them, as nicely as possible, with a Microscope, I observed that those Cells, in which the Oyl of the said *Almond* was for the most part contained, consisted also of nothing but little Vessels.

Now when I perceived, that the before-mentioned little Cells proceeded from the Bark, or Skin, which surrounds the Kernel of the Seed, or Grain, I was thinking that, as the mealy Substance receives it's increase from the Vessels, which are in the little Cells, and as the Plant is formed between the Cells, during the time that the Seed lies in the Earth, and as the little Orifices in the Skin of Animals and Fruits, are formed in order to discharge thereby the Superfluity of their Moisture, and shut in such a manner, that no Moisture, nor common Air, can get into the same, as I have formerly advanced: So on the contrary, the Orifices of Seeds are so formed, that many of their little Vessels admit Moisture to pass inwards, and accordingly Water is driven into them by the pressure of the Air, and causes the Seed to swell; upon which, a Warmth and Fermentation succeeding in the Seed, it requires a greater space, and by the particular Formation of the Particles, which lie in the Cells, and which have derived their Encrease from the Cells, the mealy Substance, of which they consist, is partly driven out of them into the body of the young Plant, which by this means encreases so much in bulk, that the Root is now able to supply it with Nourishment from the Earth, at which time the Seed is found to be diminished in it's bigness.

X. I happened to take up a boiled grey Pea, out of which I took a little of the mealy Substance, and laid it before a Microscope, where it appeared to consist of such like Parts as are found in Rats Dung, every one of which Parts consisted of a great number of very small Particles. But I could not discover any Membranes enveloping those Parts, from whence I concluded, that those Membranes were destroyed and dissolved by the hot Water.

Upon this, I took another Grey Pea, which had not been boiled, and cut it into very thin Slices, when I not only saw the Membranes,

*Of the Vessels  
in Grey Peas  
by the same,  
N<sup>o</sup>. 368. p.  
199.*



in which the Parts of the mealy Substance had been enclosed, but found likewise, that those Membranes consisted of nothing else but a great number of very small Vessels, like the Membranes, as they are commonly called, which surround the Muscles and muscular Fibres in Beasts and Fish.

*Observations  
upon the Vessels  
in several  
sorts of Wood,  
by the same,  
No. 367. p.  
134.*

XI. I procured a piece of reddish Wood brought from *Amboina*, sawed off at the end of a Board, as likewise some of the Chips, in order to observe the Vessels therein; and, cutting the Wood through all manner of ways, I found that in one place it appeared whitish, at a small distance red, and in another place blackish. Upon cutting it transversely, I saw the Orifices of the ascending Vessels, which ran along the length of the Wood, and appeared of such a size in the Microscope, that one would have judged a Pea might pass through them. Where the Wood looked reddish, I found these great Vessels filled with a substance of a fine red colour, so that I imagined, that these great Vessels carried a red Sap into the Horizontal Vessels, which appeared so very numerous, and so thick together, that they caused the Wood to appear of the same colour with the red Substance which was contained in them.

I afterwards cut off some very thin slices transversely and putting them into a *China* Cup, I poured hot Water upon them, and suffered them to lie in it for some time; then viewing them with a Microscope, I observed that the red Substance was extracted by the Water, and no red colour was now to be found in any of the Vessels.

What seemed the strangest to me in this Wood was, that cutting through it lengthways, as I frequently did, I observed it to be of a fine red colour for one Hair's breadth, and a Hair's breadth farther it appeared white; and the ascending Vessels seemed to be smaller, where the Wood was red, than where it was white: which narrowness of the red Vessels I judged to proceed from the Sap contained in them.

In viewing the ascending Vessels in Oak, I found some other Vessels which entered into their sides, and appeared to me like so many small round holes, especially where the Horizontal Vessels lay, which I judged to be united to the ascending Vessels, by means of those small Orifices, and thereby to discharge part of their Sap into them.

Taking a small Twig of an Oak, which in seven Years growth was grown to about the thickness of one's Finger, I cut it through according to the length both of the ascending and horizontal Vessels which last I saw lying in great Numbers very close together, and proceeding directly from the Pith of the Twig.

I have likewise made some Observations upon Fir Wood, in which the ascending Vessels consist of so very fine and thin a Substance, that they exhibit a very delightful Spectacle in the Microscope. In these ascending Vessels I imagined that I saw some Globules, with a small opening



opening in their middle, which seemed to be of a closer and denser Substance than the rest of the Wood. But I afterwards found myself mistaken, and that these supposed Globules were nothing else but the Orifices, whereby the ascending and horizontal Vessels were united together, and through which the Sap was carried from the one to the other.

XII. Ex Planta illius Buxi, quæ Vulgo *Palma Ceres* appellatur, folium decerpsi, & in partes divulsum ope Microscopii contemplatus sum. Tum vero partes illas, per quas Transpiratio vel Exhalatio fit, clarissime visu distinxī. Adhæc complures percepi exiguissimos Hiatus, qui lucem transmittēbant: Quos tamen commodius majorique numero percepi, cum partes prædicti folii aliquanto essent sic-  
*Of the Pores of the Leaves of Box; and of the Down of Peaches and Quinces, by the same. N<sup>o</sup>. 369. p. 231.*

Ex alia Buxi Arbusculâ quædam Foliola, partim adhuc virentia, partim exsiccata, mihi adferenda curavi, ut illorum Texturam, quantum possibile esset, investigarem: Quod eo Successu feci; ut istiusmodi Oscula, sive Spiracula, in foliis istis clarius Visu perceperim, quam in ullis unquam Fructibus ante percepissem. Ut autem Multitudinem Osculorum quæ in tali Foliolo percepi, velut Oculis expositam haberem; Folium Buxum Lineali imposui cupreo, quod in varias partes distinctum erat: Comperique Longitudinem Folii parem esse octonis partibus Pollicis, in decem partes distributi Folii vero Latitudinem cum medietate pollicis, sive quinque decimis partibus exæquari.

Jam vero ponamus tali Foliolo Figuram esse Ovata; adhæc Latitudinem ejus atque Longitudinem jungamus: Tum exsurget numerus 13, cujus dimidium sit  $6\frac{1}{2}$ . Dein ponamus idem Foliolum, post illam Latitudinis atque Longitudinis conjunctionem, instar Circuli esse rotundum; illiusque Diametrum  $6\frac{1}{2}$  decimis Pollicis partibus ex æquo respondere.

Exinde juxta Foliolum ante dictum, locavi Pilum Porcinum; quem adhibito Microscopio contemplatus, judicavi duodecim Buxi Oscula, si sibi contigua jacerent, cum Diametro Pili Porcini Longitudine exæquari; Sexaginta vero Pilos Porcinos judicabam Magnitudinis esse pollicaris. Sequitur decimam quamque Pollicis partem sex Diametris Pilorum Porcinatorum Longitudine parem esse; dimidiatam vero Diametron Folioli Buxei cum  $19\frac{1}{2}$  Diametris Pilorum Porcinatorum exæquari. Quæ  $19\frac{1}{2}$  Diametri, si duodecies, id est juxta numerum Osculorum, multiplicentur; efficitur numerus 234, quam Longitudinem dimidiatus Folioli Buxei circulus ex antedictis habet.

Ut autem quid tali Circulo contineatur supputemus, primo cum Geometris statuendum est; quæ proportio est numeri 14 ad numerum 11, eandem Proportionem esse inter numerum quadratum Diametri cujusvis Circuli, & ea quæ Circulo ipso continentur. Sequitur unam Folioli Buxei Superficiem Osculis 172090 præditam esse. Cum autem altera Superficies haud paucioribus instructa sit; tandem exsurget



numerus Osculorum 344180, quorum Ope Perspiratio & Exhalatio fiat.

Cum Lanuginem illam, quæ Mala Persica, vulgo Montana con-vestit, nupera Æstate sine Microscopio considerarem; Frustrula quædam Mali Persici, ex cortice excisa, ante Microscopium collocavi. Tum vero judicabam Floccos illos Laneos Multitudine pares esse Osculis per cutem Mali Persici diffusis. Et quemadmodum Oscula Fructuum velut inter duo labiola patefcere, nec plane rotunda sed aliquantulum oblonga esse, jam ante monui; sic Flocci Lanei, ex Osculis dictis efflorescentes, non omnino rotundi sunt, sed nonnihil plani. Sed & complures in medio Ruga quadam notatos esse videbam.

Ut autem Multitudinem Osculorum halitus exspirantium palam proponam; unâque ingentem numerum exhalantium humorum, qui Aërem ingressi in particulas oblongas, sed alias aliis longiores spifescunt, Oculis subjiciam; exiguam Mali Persici portionem delineari A B F G perpufillum est Frustum Mali & Corticis Persici, B C D E F lanugo Malo adhærescens designatur.

Fig. 110.

Magnitudinem dicti Frustruli, per Iconem designati, sic æstimare poteris: Tres Vultus mei Pilos Microscopio applicatos habebam, quos Pictori post Iconis modo dictæ Delineationem intuendos exhibui. Cum deinde ejusdem Iconis Longitudinem, a G ad A in 16 Partes distribuisssem; rogavi quot latorum pilorum Diametros in illa Iconis Longitudine contineri judicaret; qui, *ne octo quidem* respondit. Quod si verum esse statuamus, quam incredibili Floccorum Laneorum Multitudine necesse est Malum Persicum circumvestiri!

Cum postea Mala Cydonia permaturuissent, quasdam etiam Mali Cydonii particulas ad Microscopium applicavi; & Lanuginem, quæ ex Malo Cydonio exhalatur, neque Lanugini Mali Persici copiâ cedit, delineandam curavi; H I N O perparva est portio Mali Corticisque Cydonii, I K L M N Lanugo ex Malis Cydoniis exsudans. Quæ Lanugo, licet in Cydoniis longior quam in Persicis, non tamen in illis erigitur, sicut in istis; sed crispando sibi invicem implectitur.

Fig. 111.

*The Anatomical Preparation of Vegetables, by Albertus Seba, F. R. S. No. 416. pag. 441.*

XIII. Those Leaves only of Plants, are fit for this Purpose, whose inward Structure is composed of woody Fibres; and which are of a pretty good thickness and consistence, as the Leaves of Oranges, Lemons, Jasmins, Bays, Roses, Cherries, Apricocks, Peaches, Plumbs, Apples, Pears, Poplirs, Pines, Oaks, Ivy, &c.

There are several other Leaves which have no woody Fibres or Veins; as for Instance of Vines and Lime Trees, but these dissolve without separating.

These Leaves are to be gathered in *June* or *July*, when they are full grown and have not been damaged by Worms or Caterpillars. They are to be put into an earthen Pot or large Glass, with a good deal of Rain-Water, the Pot or Glass being kept uncovered and so exposed



Fig. 109.



Fig. 110.

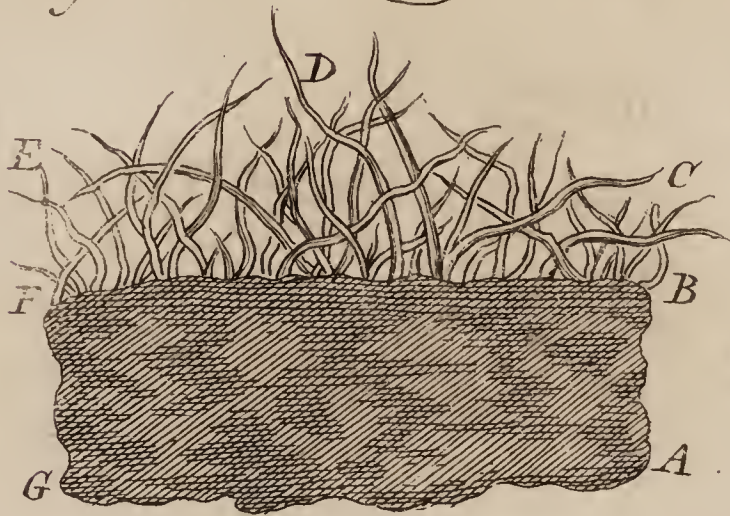
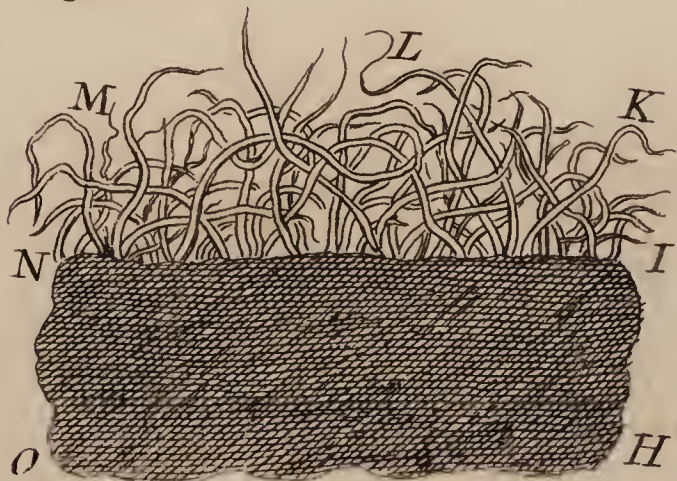


Fig. 111









exposed to the Sun or open Air. The Leaves must be quite covered with Water, and as it evaporates, a fresh quantity must be poured in. In about a Month's time some of the Leaves will begin to putrify, but, others must be kept two Months or longer. When the two external Membranes begin to separate, and the green Substance of the Leaf to grow liquid, then it is Time to perform the Operation. The Leaf is to be put into a white and flat earthen Plate or Dish filled with clear Water; then upon gently squeezing it with the Finger, it will open on one side and the green Substance will run out. Immediately on that the two outer Membranes must be stript off chiefly in the middle and along the Nerves when they adhere closest: If there is once an Opening, they will go off very easily. The Skeleton that remains between is afterwards washed in clear Water, and kept between the Leaves of a Book.

The Method of preparing Fruits; as Apples, Pears, Plumbs, Cherries, Peaches and the like, is as follows.

The finest and largest Pears that are soft and not Stony, are fittest for this Purpose, First, they are to be nicely pared without squeezing them, and Care taken not to hurt the Stalk or the Crown. This done, put them into a Pot of Rain or fresh Spring-Water; cover it, and let them boil gently till they grow thoroughly soft; then take them out and put them into a Bason of cold Water: Then take out one of them and holding it by the Stalk with one Hand, and with one Finger and the Thumb of the other Hand, rub the Pulp gently off, beginning near the Stalk and rubbing equally towards the Crown, and you will easily see in the Water how the Pulp separates from the Fibres, which being most tender towards the Extremities, it is there the greatest Care is to be taken. No Instrument is of any use in this Operation, except last of all a Penknife to separate the Pulp sticking to the Core. In order to see how the Operation advances, you may fling away the muddy Water from Time to Time, and pour on clean: All being separated, the Skeleton is to be preserved in Spirits of Wine rectified. The same to be observed with relation to Apples, Plumbs, Peaches and the like.

Carrots and other Roots, that have woody Fibres must be boiled without paring, till they grow soft, and the Pulp comes off. Not only many sorts of Roots, but also the Barks of several Trees may be reduced after this Method into Skeletons, presenting rare and curious Views of Vegetables.

☞ *This Paper is corrected from a Translation of the same Original, by the late Dr Scheuchzer. It was read before the Society Oct. 17. 1728, above two Years before the publication of Mr Zolman's Translation in the Philosophical Transactions.*



Of the Veins  
and Arteries  
of Leaves.

By Frank Ni-  
cholls, M. D.  
F. R. S. No.

414. pag.  
371.

XIV. By a Letter from Dr *Fuller* in *Holland* to the President, and communicated about *October* 1729, the Society was informed, that Professor *Ruyfch* had observed something in the dissecting of Leaves analogous to the Veins and Arteries of Animals; but without explaining in what Manner these different Vessels were disposed, or by what Means they may be distinguished from each other.

When I examined the Collections of *Frederic Ruyfch* and *Albert Seba* at *Amsterdam*, in both which were great Variety of dissected Leaves, they made no Mention of such a Discovery; although in a Leaf from the Collection of *Ruyfch* I could (with a Glass) observe the Fibres to be double towards the Edges of the Leaf; which at that Time I imagined to be an unnatural Division of the Fibres, as in decayed Sticks.

In the mean Time, *Albert Seba* having communicated the Method of dissecting Leaves, to the Society, I separated the pulpous from the fibrous Parts of several Leaves after his Method; when examining them by Glasses, and in Water, I found that each Fibre was naturally separated into two distinct Fibres by a thin *Stratum* of the pulpous Substance; and that this Separation was continued through all the Fibres and Stem of the Leaf, so as to form two distinct Planes of similar Net-work.

Though this Duplication of the Vessels in Leaves seems to point out an Analogy between them and the Veins and Arteries of Animals, yet I see no probable Means of guessing which are the arterial and which the veinal Fibres.

Fig. 112, 113.

That I might illustrate this Matter, as it appeared to me, I have prepared two Leaves, the one of an Apple (*Fig. 112.*) the other of a Cherry (*Fig. 113.*) in which, as well the Separation of the Fibres and Stem, as the pulpous Substance, by which they are naturally separated, are very obvious.

Of the change  
of Colour in  
Grapes and  
Jasmine, by  
Mr Henry  
Cane, No.  
366. pag.  
102.

XV. About six Years ago \*, I planted a cutting of a Vine against a Wall, on an Eastern Aspect, where it has the Sun from it's Rising till half an Hour after twelve. The soil is a stiff Clay, but to make it Work the better, I meliorated that, by mixing some Rubbish of the Foundation of an old Brick-Wall, where it now grows. In *January* last was twelve Month I pruned it, and the Figure was thus,

Left Hand **T** Right Hand *Black*

At time of Year it shot at both Hands about twenty two Inches of a side, before it came to a Joint; that on the Right was a very luxurious exuberant Branch, as big as the body of the Tree, the other side not half so thick or big, and the Leaves on the Right were as big again as the other on the left Hand, and I fancy the largest that were ever seen. The right Hand bears a very large and good black

\* This was written in October, 1720.



Grape, and large Bunches; the left hand very good white Grapes, and I had last Year more Bunches of the white, than of the black; and whereas in all Vines bearing black and blue Grapes the Leaves die red, these died white on the black side as well as t'other. Last *January* I pruned the Tree again, but tacked up more of the right Hand (being black) than I did on the left, for which reason I had this Year a great many more of the Black than I had of the white, and they ripened for the Season of the Year very well; divers Gentlemen of the Country both saw them last Year and this Year, and tasted of them. I gathered the last about eight days since, and the Leaves die white this Year also, being the second Year that ever it bore. I think to prune it pretty close on both sides this Year, and to plant out divers cuttings of both sorts of it.

I will mention one thing more, which I have experienced about 28 Years since; I do it because Mr *Lawrence* in his first Tract of Gardening, makes mention of the Plant, but I take mine to be a much different case from his; I mean the yellow and green striped *Jessamine*. In the Month of *April* Ann. 1692, having a small Plant of our common white *Jessamine*, which stood in the ground, and was no bigger than a Tobacco-pipe, I cut it off at two joints above the ground, and grafted it with a cutting of the yellow striped; it took and shot a small weak Shoot, and in a Month or five Weeks after, it was blighted, and I perceived it had killed the Graft, and some part of the Stock below, and so I took my knife and cut it to the quick, which was near the next knot or joint to the Ground, and let it stand, thinking to graft it again at Spring, as before, but forgot it 'till the Season was past. At length going that way I saw it had broke out at the next joint with several Shoots of the yellow and green striped, and not only there, but it had also made a strong Shoot from the Root, of yellow and green striped; after a while I took it up with Mold to the Root, and put it in a Pot, and it flourished all the Summer. But afterwards having made a present of it, it flourished two or three Years, and then for want of shifting the Pot in time, it was matted so to the sides and bottom of the Pot, that it died; I also at that time gave several of my Acquaintance an account of the Circulation and Descent of the Sap in that Plant, and I have tried several other sorts of variegated Plants, but do not find any of them to transmute, as that *Jessamine* will do.

XVI. The Plants of *England*, as well those of the Fields and Orchards, as of the Garden, that have been brought over hither, suit mighty well with our Soil, and grow here to great Perfection.

Our Apples are, without Doubt, as good as those of *England*, and much fairer to look to, and so are the Pears; but we have not got of all the Sorts.

Our Peaches do rather excel those of *England*, and then we have not the Trouble or Expence of Walls for them; for our Peach Trees

Observations  
on some of the  
Plants in  
New-Eng-  
land; with re-  
markable In-  
stances of the  
Nature and  
Power of Ve-  
getation, by  
are



*the Hon. Paul  
Dudley, Esq;  
F. R. S. No.  
385. p. 194.*

are all Standards, and I have had, in my own Garden, seven or eight Hundred fine Peaches of the Rare-ripes, growing at a Time on one Tree.

Our People, of late Years, have run so much upon Orchards, that in a Village near *Boston*, consisting of about forty Families, they made near three Thousand Barrels of Cyder. This was in the Year 1721. And, in another Town of two Hundred Families, in the same Year, I am credibly inform'd, they made near ten Thousand Barrels. Some of our Apple Trees, will make six, some have made seven Barrels of Cyder, but this is not common; and the Apples will yield from seven, to nine Bushels for a Barrel of Cyder. A good Apple Tree, with us, will measure from six to ten Foot in Girt. I have seen a fine Pearmain, at a Foot from the Ground, measure ten Feet, and four Inches round. This Tree, in one Year, has born thirty eight Bushels, (by Measure) of as fine Pearmain, as ever I saw in *England*. A *Kentish* Pippin at three Foot from the Ground, seven Foot in Girt; a Golden Rossetin six Foot round. The largest Apple Tree, that I could find, was ten Foot and six Inches round, but this was no Graft.

*Pear Trees.*

An *Orange* Pear Tree grows the largest, and yields the fairest Fruit. I know one of them near forty Foot high, that measures six Foot and six Inches in Girt, a Yard from the Ground, and has born thirty Bushels at a Time; and this Year I measured an *Orange* Pear, that grew in my own Orchard, of eleven Inches round the Bulge. I have a Warden Pear Tree, that measures five Foot six Inches round. One of my Neighbours has a *Bergamot* Pear Tree, that was brought from *England* in a Box, about the Year 1643, that now measures six Foot about, and has born twenty two Bushels of fine Pears in one Year. About twenty Years since, the Owner took a Cyon, and grafted it upon a common Hedge Pear, but the Fruit does not prove altogether so good, and the Rind, or Skin, is thicker than that of the Original.

*Peach Trees.*

Our Peach Trees are large and fruitful, and bear commonly in three Years from the Stone. I have one in my Garden of twelve Years Growth, that measures two Foot and an Inch in Girt, a Yard from the Ground, which, two Years ago, bore me near a Bushel of fine Peaches. Our common Cherries are not so good as the *Kentish* Cherries of *England*, and we have no Dukes, or Heart Cherries, unless in two or three Gardens.

*Trees of the  
Wood.*

Some Years since, I measured a *Platanus Occidentalis*, or *Button* Wood Tree (as they are called here) of nine Yards in Girt, and it held it's Bigness a great Way up. This Tree, when it was cut down, I am informed, made twenty two Cord of Wood. A Gentleman tells me, that in the Forest, he met with a straight Ash, that grew like a Pillar, of a great Height, and free from Limbs, that measured fourteen Feet eight Inches round, near a Yard from the Ground; and,



and, the other, Day, I met with a *Sassafras* Tree, that measured five Foot three Inches in Girt. I meddle not here with our noble Pines and Cedars, because I design to treat of them in a Chapter of the Evergreens of this Country. Among our Trees of quick and easy Growth, the *Button Wood* before-mentioned, and the *Locust* Tree, are the most remarkable: As to the latter, by the Description Mr *Moore*, while in *New-England*, gave me of the *Manna* Tree, our *Locust* Tree may be called the *American Manna*. I have known a Seed of it blown off from the Tree into my Garden, that took Root of itself, and, in less than two Years, was got above six Foot high, and as big about, as a common walking Cane. The *Platanus* I have frequently propagated, by cutting off Sticks of five or six Foot long, and setting them a Foot deep into the Ground in the Spring of the Year, when the Season is wet; they thrive best in a moist Soil.

An Onion, set out for Seed, will rise to four Foot nine Inches in *Garden* Height. A Parsnip will reach to eight Foot, red *Orrice* will mount nine Foot, white *Orrice* eight. In the Pastures, I measured Seed *Mullen* nine Foot two Inches in Height, and one of the common Thistles above eight Foot.

Among the remarkable Instances of the Power of Vegetation, I *Vegetation* shall begin with an Account of a Pompion Seed, which I have well attested, from a worthy Divine \*. The Relation is as follows: That *Pompion* in the Year 1699, a single Pompion Seed was accidentally dropped in a small Pasture where Cattle had been foddered for some Time. This single Seed took Root of itself, and without any Manner of Care; the Vine run along over several Fences, and spread over a large Piece of Ground far and wide, and continued it's Progress till the Frost came and killed it. This Seed had no more than one Stalk, but a very large one; for it measured eight Inches round; from this single Vine, they gathered two hundred and sixty Pompions; and, one with another, as big as an half Peck; enough in the Whole, to fill a large Tumbrel, besides a considerable Number of small and unripe Pompions, that they made no Account of. The *Philosophical Transactions* give an Account of a single Plant of Barley, that by steeping and watering with *Salt-Petre* dissolved in Water, produced two hundred and forty nine Stalks, and eighteen thousand Grains; but then there was Art, and even Force in that Case; whereas in ours, there was nothing but pure Nature and Accident.

Our *Indian Corn* is the most prolific Grain that we have, and com- *Indian Corn* monly produces twelve hundred, and often two thousand Grains from one; but the fairest Computation is thus; six Quarts of this Grain will plant an Acre of Ground, and it is not unusual for an Acre of good Ground to produce fifty Bushels of Corn. *Indian Corn* is of several Colours, as blue, white, red, and yellow; and if they are planted

\* *The Rev. Mr Edwards of Windsor.*



separately, so that no other Sort be near them, they will keep to their own Colour. But if in the same Field, you plant the blue Corn in one Row of Hills (as we term them) and the white, or yellow, in the next Row, they will mix and interchange their Colours; that is, some of the Ears of Corn, in the blue Corn Rows, shall be white, or yellow; and some again, in the white or yellow Rows, shall be blue. Our Hills of *Indian* Corn are generally about four Foot asunder, and so continued in a straight Line, as far as the Field will allow; and then a second Line, or Row of Hills, and so on; and yet this mixing and interchanging of Colours has been observed, when the Distance between the Rows of Hills, has been several Yards; and a worthy Clergyman \*, of an Island in this Province, assures me, that the blue Corn has thus communicated, or exchanged, even at the Distance of four or five Rods; and, particularly in one Place, where there was a broad Ditch of Water betwixt them. Some of our People, but especially the *Ab-Origines*, have been of Opinion, that this Commixtion, and Interchange, was owing to the Roots, and small Fibres reaching to and communicating with one another; but this must certainly be a Mistake, considering the great Distance of the Communication, especially at some Times, and cross a Canal of Water; for the smallest Fibres of the Roots of our *Indian* Corn, cannot extend above four or five Foot. I am therefore humbly of Opinion, that the *Stamina*, or Principles of this wonderful Copulation, or mixing of Colours, are carried by the Wind; and that the Season of it is, when the Corn is in the Earing, and while the Milk is in the Grain, for at that Time, the Corn is in a Sort of Estuation, and emits a strong Scent. One Thing, which confirms the Air's being the Medium of this Communication of Colours in the Corn, is an Observation of one of my Neighbours, that a close, high board Fence, between two Fields of Corn that were of a different Colour, entirely prevented any Mixture or Alteration of Colour, from that they were planted with.

*Apple Tree,  
without Blossoms.*

An Apple Tree in my own Town bears a considerable Quantity of Apples, especially every other Year, which never had a Blossom; I had formerly heard the Owner speak of it: But for the three last Years, I made it my Business, in the proper Season, to go and observe it myself; and when all the rest of the Orchard was in the Bloom, this Tree had not one Blossom. Not being contented with once going, I went again, and again, till I found the young Apples perfectly formed. The last Year, I went early, not knowing but that it might blow sooner than the other Trees, but I found no Blossoms; and the Owner, with many of his Neighbours, assured me, they have known the Tree these forty Years, and that it never had a Blossom. I opened several of the Apples, and observed but very

\* *The Rev. Mr Mayhew, of Martha's Vineyard.*



few Seeds in them; and some of them lodged single in the Side of the Apple. This Tree was no Graft, and the Fruit but ordinary for Taste. I could not perceive, by my Observation, but that, in all other Respects, it fructified like other Apple Trees.

XVII. It is no small Satisfaction, that what I advanced in my *Botanic Essays* is now so fully confirmed by Experiments made by some curious Gardeners, among whom is Mr Philip Miller, who writes me word, November 11, 1721,

*Observations upon the Generation of Plants, by Patrick Blair, M.D. F.R.S. No. 369. p. 216.*

That in Pursuance of my Advice he separated the Male Plants of the Spinage from the Female; the Consequence of which was, that the Seeds swelled to the usual Bigness; but that they did not grow when he sowed them. He searched into the Seed, and found they wanted the *Punctum Vitæ*, which perhaps might have been the Case with Mr Geoffroy; but if not, the female *Embryones* might have been impregnated another Way, as he experimented with twelve Tulips, which he set by themselves about six or seven Yards from any other, and as soon as they blew, he took out the *Stamina* so very carefully, that he scattered none of the Dust, and about two Days afterwards, he saw Bees working on Tulips, in a Bed where he did not take out the *Stamina*, and when they came out, they were loaded with the Dust on their Bodies and Legs: He saw them fly into the Tulips, where he had taken out the *Stamina*, and when they came out, he went and found they had left behind them sufficient to impregnate these Flowers, for they bore good ripe Seed; which persuades him, that the *Farina* may be carried from Place to Place by Insects, and when they happen upon a Flower, whose *Uterus* is capable of being impregnated by such a Dust, it may be thus effected.

I am of Opinion, this will not suit with Mr Morland's Scheme. For tho' we may suppose the *Stamina* of every Flower to be loaded with a due Proportion of the *Farina* yet this accidental Conveyance of it to a neighbouring Flower, may be rather less than greater than is necessary: So that, if wanting, then those *Embryones*, which had not received it's determined Particle into their Bosom, must be defective in Bulk, or barren in growing, but here all were equally filled.

By another Letter, October 19. 1721, he informs me, that he bought a Parcel of Savoy Seeds of a Neighbour, which he sowed, and planted out the Plants; but was surprized to see the Production: For he had half of them red Cabbages, and some white Cabbages, and some Savoy with red Ribs, and some neither one Sort nor other, but a Mixture of all Sorts together in one Plant. He went to the Gardener and told him his Tale, who shewed him that he was in the same Condition, but did not know how it should come to pass, for he was sure he took special Care in saving of the Seed. Being asked how and where he planted them for Seed, he shewed him them under a South-West Hedge, and told him the Man-



ner in which he planted them: First, a Dozen of white Cabbages, then a Dozen of Savoy, and then a Dozen of Red. Then he immediately thought how it came to pass, by the *Effluvia* impregnating the *Uterus* of one another; and it is very common for our Gardeners to plant white and red Cabbages together for Seed, and they are as often disappointed by having a Degeneracy of both Kinds, which they attribute to the Soil, They send to *Holland* for a fresh Supply of Seeds, and say our Soil will not continue that Sort good. He told them his Opinion, and they laugh at him for it, and will not be turned out of their Road, although they should have never so many Experiments shewed them.

This Experiment is a most convincing Argument for the *Effluvia*; for did each Grain of the *Farina*, enter the *Pistillum* to it's proper *Uterus*, this mongrel Kind would never be produced. For if the individual Plant be in each Grain of the Male *Farina*, how can it be so far dismembered, as that one Part shall go to the making up of the Ribs of Red Cabbage, and another to compose the rest of a Savoy Plant. Analogous to this, is what I lately observed in a Spaniel Bitch, of so good a Kind, that when she became proud, Care was taken to let her have good Dogs. The Litter she produced, consisted of Puppies some piebald, like one of the Dogs that had lined her, of the same Shape, Colour, and Spots; others like another; and a third partaking of both, with spots from the Bitch interspersed. This is a farther Confirmation of what I have advanced, *Essay* 4. where, pag. 310, I only assert, that several Fœtus's partake equally of Male and Female; but here two Males concur with one Female in the Composition of a fourth Body, made up of all the three: And one Seed produces a Cabbage consisting of three different Species, which could never happen, did these organized *Animalcula*, or Granules of the *Farina*, become a Fœtus, or contain the *Folia Seminalia* of a Plant. This methinks is sufficient to answer what Mr Bradley has so strenuously contended for, *Works of Nature*, p. 9. & seq.

I could descant yet more upon this Observation, and consider how far this may lead us into the infinite Variegations and Stripes, in not only annual Flowers, such as Poppies, *Consolida Regalis*, and Bottles, but also in perennial Roots; such as Auricula's, Cousslips, &c. of a lower Size, which is hinted by Mr Bradley; he having received that Notion from Mr Du Bois, as I have been credibly informed; and in Plants of larger Size, not of a Bulbous, but Carnous Root, such as Columbines; where there is a vast Variety: And in this Plant it is most especially to be observed, that though the indigenous one, from which all the other seem only to be Variations, and not determinate Species, be of a blue Colour, consisting of ten alternate Petala, viz. five corniculate, and five plain; yet into how many other Kinds of Flowers is it subdivided; such as pale yellow



low, with bluish red, purple, dark Stripes vastly double, blue, blackish red, &c. Some with corniculate *Pétala*, and some only with plain, and how in single Flowers it imitates all the Colours we see Pigeons endowed with. I say it is worthy of Consideration, whether the *Farina* may do this, since I do not understand there has been much Art used in making these Flowers break, as Tulips, or to cultivate a Set of Breeders; but that a richer Soil may produce a double flower; and a suitable Loam may produce the Variety of Colours; the *Farina* from several Flowers may occasion the Stripes, and the *Stamina* arising from the plain *Petala*, rather than the *Cornicula*, pouring out the *Farina*, may cause the Flowers with the plain *Petala*. So that were I to extend this to a great many other Plants, and were there proper Observations made in them, considerable Improvements might be made upon this Doctrine of the Sexes of Plants. For after the Flowers, we come next to the Variegation of the Seed of some Plants, particular the *Phaseoli*, whose various Spots and Colours, and even the Bigness too, may very much depend upon the *Effluvia* from the *Farina*, when several Kinds are sown together. For do but consider three plain Colours, a White, Red, and dark Blue, and you may observe how many Descendants, and what a Variety of Spots may proceed from them, the Lupines also in some Measure may be brought in here, and I know not but that the *Medica cochleata falcata lunata*, may be multiplied in it's Variations after the same Manner. But it is Time to proceed to another Experiment of my Correspondent Mr Miller.

Being persuaded to it by an ingenious Gardener, he pulled off all the Male-Flowers of some Melon Plants so soon as they appeared; but instead of finding, as his Friend informed him, that these Flowers exhausted the Nourishment from the Fruit; he found that, without these Flowers; none of the Melons would grow.

As this Experiment is a plain Indication of the Necessity of the *Farina*, so it confirms the Use I have assigned to the Leaves, viz. that by entering the Capillaries of the Leaves, and returning, the nutritive Particles may be more attenuated: So here, the *Petala* of the Male-Flowers may serve for the same Purpose; for by the Largeness of the *Tubuli* in these *Pomiferæ scandentes*, a gross viscid Sap is received, which even the Leaves themselves are not sufficient to attenuate, so as to be fit for composing the more subtile Part of the Fruit; until by repeated Circulation through the *Petala* of the Male-Flowers, it may be rendered fit for such a Purpose. Indeed, the Female-Flowers upon the Top of the *Rudimentum Fructus*; may in some Measure serve for this Purpose. But as the Male-Flowers are, generally speaking, more numerous than the Female, so their being removed must deprive the *Embryones* of a very great Assistance towards it's being perfected: I may add, that the Orifices of the Pedicles, when the Flowers are pulled off, must lose so much of the Sap,



that the whole Plant must be thereby so impoverished, as not to be able to bring forth the designed Fruit; all this, beside the Want of the considerable Supply of the *Farina Fæcundans*.

I designed to have given a few Thoughts concerning the Variegation of Leaves and Flowers, being unwilling to admit of Mr *Bradley's* Sickness or Weakness of the Sap: But I shall reserve that to a more convenient Opportunity, being at present intent upon making some farther Improvements upon the Generation and Nourishment of Plants.

*The Propagation of Mistletoe, by the Rev. Mr Edmond Barrel, Rector of Sutton in Kent. N<sup>o</sup>. 397. p. 215.*

XVIII. 1. The Berries of *Mistletoe* have within their viscid Pulp a Kernel covered with a thin whitish Skin; the inward Substance whereof is deeply green, and harder than the Substance of a *Pistachio* Nut's Kernel. It is flattish, and shaped sometimes like a Heart, sometimes oblong, both are as truly Seed, as any Plant can have. Those of the oblong Shape put out but one *Germen*; those like an Heart, have two, which prove two distinct Plants.

Fig. 114.

Fig. 115.

Sir *John Colebatch* recommends the sowing this Seed by way of Inoculation: Accordingly in Feb. 17<sup>18</sup>/<sub>19</sub>, I endeavoured to place the Berries, within the Bark of Oak, Ash, Beech, Pear, and Apple-trees, by making several Cuts and Gashes in the upright Sides of the Trees. The whole Berries would not stay in any of them; and when I broke them, the Seed always slipped out to the Edge of the Cut, and then it stuck to the Bark, by means of the slimy Substance wherewith it is encompassed. I also stuck one Seed on the bare Bark, without any cutting at all: This succeeded best, and being the Heart-like shape, gave me two Plants. For about the 28<sup>th</sup> of March 1719. this with two more on the Apple-tree, and one on the Pear-tree, began to shoot; and the Growth was in this manner:

The viscous Matter having stuck the Seed on, and (as it dried) drawn the Seed close and flat down to the Bark of the Tree, there began, in March and April, to spring out of that end of the Seed which had been toward the Eye of the Berry, a small deep green Shoot or Twigg, very like a short Piece of a little Clasper of the Vine. At first, it arose upward from the Bark and then turning again, as it approached the Tree, it swelled out somewhat bigger round about the End; yet leaving the very Tip or Bottom, quite flat, forming (as it were) a Foot to stand upon; not unlike the bottom of some Brass Pestles. This Foot, when it came to the Bark, which was about May or June 1719, fixed itself thereon. Being thus fastened at both Ends, it made a little Arch whose Diameter was as long as the Seed, or about  $\frac{1}{10}$  of an Inch.

In this Condition, it remained all that Year, till about March or April 1720, and then that part or end of our little Seedling, which was joyned to the Bark, at the place where the Seed first shot forth, let go it's hold, and raising itself upward, put forth Leaves, and became the Head of the Plant: and the other end, which sprung out first,



first, and had taken footing in another Place, became the Root of the Plant.

'Tis no uncommon thing, for Seeds of *Ever-greens* to be two Years before they spring out of the Ground. And the change of the Ends, first one of them shooting out, and then the other, was what surprized me most at first; but on further reflection I found, that Nature, in this Plant, is uniform to her other Productions; in carrying the Sap first one way to form the Root, and then turning the Course of it back again to send out the upper parts of the Plant. The strangest and most wonderful part is, that the rooting End should make it's first shoot into the open Air, and then turn it self down to find a proper Place to fix upon. Who could have supposed, that a Plant, whose Berry is the most orbicular of any, and therefore the least likely to lie quiet in any Situation, and whose proper place of growth is a round and wavering Bough, or upright side of a Tree, should after it is once fixed, leave it's first footing, and seek out a new point in the Bark to grow upon.

This is indeed the great Secret of the matter, and seems to be the very thing that hath kept the World in Ignorance, about the growing of this Seed. For by requiring a new smooth Place of the Bark whereon to fix the rooting Part, it hath frustrated all attempts of sowing it in the usual way of other Seeds.

*Theophrastus*, (about two Thousand Years ago) seems to endeavour at a Reason, why this Seed could not grow in the Earth: But all that he, or any one since, hath said upon it, is only to agree, that in Fact it doth not, and to wonder why so perfect a Seed should not grow in the Earth. That Antient Author rationally concluded, from it's having a Seed, that the Plant must come from that Seed: Whereas latter Times have been so fond of allowing Chance a share in the Productions of Nature, that *Scaliger* hath not only experimentally confuted the common Notion of *Mistletoe's* being sown in the Dung of the *Thrush*; but argueth also, very strenuously, against the Possibility of this Plant's growing from it's Seed. Even the great Lord *Bacon*, Sir *Thomas Brown*, *Lobel*, and the inquisitive Mr *Ray* (so late as 1673,) do all give into it, that this Plant, hath a spontaneous and equivocal, rather than a seminal and univocal Generation.

*Scaliger's* strongest Objection is, *Quod è Ramis quibusdam exit Viscus, quo in loco nullis modis vel stercus consistere, vel semen unquam potuerit hæerere — Nihil enim commodius consistere quam in re proclivi Globum.* *Lobel* objects against it, because of the Imperfection of the Berry *Acinulo illa pallido pellucido.* Mr *Ray's* Argument is, *Viscus innatus etiam in pronâ ramorum parte.*

If Nature had been well examined, it would have appeared, that this Seed is of a substance equal to other Kernels; and that the Pulp of the Berry, wherewith the Seed is surrounded, is of a more clammy sticking nature than the Pulp of other Berries, for this very Purpose  
that



that it might be of strength sufficient to fix the Seed on any Tree, how moveable or upright soever the Bough or Twig should be whereon it chanced to light.

And doubtless the Birds are (tho' not by their Dung) Sowers of this, as they are of many other Seeds, which they carry away for Food; but often drop in Places where they could otherwise never have come.

I went to gather some *Mistletoe*-Berries and found a Leaf with a Seed sticking thereon; doubtless by a casual Fall out of the Bill of some Bird, that has broken the Berry as she was eating it. There is both a dry string of the Slime, and a dry spot of the same, upon the Leaf that show how the Seed was detained there, in this Case; and how it must be done in like manner any where else.

I have sown these Seeds, on near thirty sorts of Trees and shrubs, and yet never had above ten Plants, that held out the second Year so that we need not wonder, at the little Success, that others have had, in their trials. This is also the Reason, why I have not been able to make many other Experiments about the growth of this Plant. However, some Casualties have furnished me with two or three; which somewhat further explain the Nature of this Plant's growing.

1. One of my little Plants sown in *Apr.* 1724. which was fixed at both Ends in it's Arch-like Form, had in *Sept.* 1724, the middle part broken off; the two Ends keeping still fast to the Tree. Which shews, how firmly the two Ends adhere, while it is in that state; and they both continued green some time, and then withered away.

2. That one Seed, which grew on a *Pear*-tree, in 17 $\frac{1}{2}$ , was the next Spring 17 $\frac{1}{2}$ , loosened from the Tree at one End, as the others were: Yet this seedling Sprout, never put out any Leaves at all; but continued in the same state, neither bigger nor less, near six Years; that is, till it was broken off by chance in *July* 1725. This seems to me a very strange thing: For, a seedling Plant (of any kind) is, but as it were an *Embryo*, till it have put forth Leaves.

3. My most thriving pair of Plants, of the Year 17 $\frac{1}{2}$ , being about three Inches in length, were on the 21<sup>st</sup> of *May* 1722, struck off, by the falling of a Rake-handle against them. They took away with them, only the outmost thin skin of the Tree; and I could not see any signs, of deeper Rooting. But as I looked, now and then, on the Place, where the *Mistletoe* had grown, I thought, I observed the Bark to swell up a little; and on the 12<sup>th</sup> of *March* 17 $\frac{2}{3}$ , I perceived 3 or 4 little Buds, putting forth, and another Bud was put out by the 18<sup>th</sup> of *March*. They all grew on, to have Leaves that Summer; and now *Febr.* 17 $\frac{2}{3}$ , they are a Cluster of Boughs, of 4 or 5 Joints in height, and bore Berries this Winter; whereas two others on the same Tree, and which were also sown at the same time



time, in 1718, and are 6 or 7 Joints in height, have not yet born any Berries.

The thriving of these Plants, so well again, after they were broken off; made me reflect, on the *Druids* way, of cutting *Mistletoe* from the *Oak*, with a Golden Instrument; a Metal not apt to take a good Edge, and possibly, the bluntness of the Instrument, might be a means, to preserve, a future growth, of the same Plant; which doubtless, they as well as we, find to be very rarely upon the *Oak*. I might suggest some Reasons for this Scarcity, from the Nature of that Bark; and I might observe many mistakes, into which both Modern and Ancient Writers run, when they mention this Plant. But I have been so tedious already, that I shall add only this one Observation; that there is almost every Year, on most *Mistletoe*-Bushes, a visible Proof, that the Kernel hath a vegetative Life in it: For when the Berries hang on till *May* or *June*, the Seed will make it's little Shoot in the Berry, as the Kernels of Lemons, and you may see it coming out at the Eye of the Berry.

2. The Birds do not often permit any Berries to be found so late as in *May*, but as I have formerly observed this, so I have met with some this Year, whereof I have herewith sent you a *Specimen*; wherein you will find both old ripe Berries and young green ones, on the same Stalks; and in the old you may see (even through their Skin) the little *Germen* putting forth it's Head from the Seed or Kernel. I have likewise formerly had a Suspicion that the Plants of *Mistletoe* are some *Male*, some *Female*. I am now further perswaded, that it may be so.

*A germinating Principle in it's Seeds, by the same, No. 399. p. 306.*

3. I have (from my own sowing of the Berries) four thriving Plants of *Mistletoe* growing on one Tree in my Garden. These, being often in my View, gave me the first Apprehension, of there being any Difference of Sex, in this Shrub. They were not of Age to bear Flower or Fruit till 1726; when one of them bore a Berry or two; and expecting that they should all do so the following Year, I frequently examined them, and found that two Plants had Berries, and two had none. I then went and examined the *Mistletoe* on other Trees, which have Plants of above 20 Years Growth. And I find the Method of Nature to be thus.

*A Difference of Sex in it, by the same No. 405. p. 547.*

Dr *Grew* observes, that many Plants make a visible Preparation in the former Year for the Flower and Fruit of the next Season. This is done by *Mistletoe*. At the latter End of *May*, the Male Plants put out little Knobs, at the Joints and Tops of their Boughs; which at first are not very unlike the young green Berries; but they soon appear evidently distinct from them, and being by the latter End of *July*, grown as large as the Berries, are then not at all like them; spreading wider upwards, and having 3, or 4, or 5 Buds, at the Top of each Knob. About *June*, the Female Plant also makes a like Preparation; putting out at the Joints and Tops of the Boughs,

Knobs,



Knobs, which are more sharp, and shorter than those of the Male; with 1, or 2, but most commonly with 3 Buds, or small Points at the Top of each Knob. I call them Buds, because in their Season they open into Flowers, both in the Male and Female Plants; all the rest of the Knob serving only for Footstalks to the Flowers, in the one Sort, and to both Flower and Fruit in the other. By the latter End of *August* the Berries are grown much larger than the Knobs on the Male Plants. And from thence, till late in *January*, there is little worth Remark in either Plant; only the Berry grows somewhat bigger, and becomes ripe; and the Knobs on the Male grow more and more yellow; so that one may, at that Time, discern a Male from a Female Plant, at a considerable Distance. By the 20th of *February* *Misselto* is in Bloom, both Male and Female. The Knobs of the Male are open at the Top with 3, or 4, or 5 Blossoms; which are very well described (though in short) in *Boerhaave's Historia Plantarum*.

The Female Plant flowereth also now, with a Blossom (which *Boerhaave* calls the Ovarium) exactly like the Male Flower; save only, that the whole Female Flower is not bigger than one Leaf of the Male Flower. They both continue in full Bloom till the Middle of *March*, when the Male Blossoms begin to wither and drop off. And by the 20th of *March* the young Berries begin to shew themselves, swelling forth, one under each Female Blossom; which often adheres to the Top of the Berry; and being carried up with it, presently withers, and soon falls off again; tho' some continued on till the 12th of *May*, when the Berries were of the Size of a great Pin's Head.

This compleated the Year's Observation. And I think it is much to be wondered at, that this Plant, which hath been the Admiration of all Ages, should (scarce ever) find one Observer so curious as to follow the Changes of it, through one whole Year's Revolution. For if this had been done with any Accuracy, it must have been very evident, that one Sort of *Misselto* was very different from the other: One Sort bearing very small Flowers with Berries succeeding them: the other bearing much larger Flowers, not succeeded by any Berries; the very Footstalk of the Male falling off with the Flower; whereas the Footstalk of the Female, becomes a Footstalk to the Berry.

*New Experiments, relating to the different, and sometimes contrary, Motion of the Sap in Plants, by Thomas Fairchild, Gardener at Hoxton. No. 384. pag. 127.*

XIX. Some Years ago, I shewed some Experiments before the *Royal Society*, and they were pleased to allow the Experiments to be new and useful; which encouraged me to try further, and bring more Experiments, in order to shew the Course of the Sap; which I find, by Experience, will be so useful, that I can make barren Trees fruitful, and decaying Trees healthful, and render the System of Gardening and Planting more useful to the Public.

I shewed



I shewed the *Laureola*, grafted upon the *Mezereon*, and the *Evergreen Oak* of *Virginia* upon the common *English Oak*; both which hold their Leaves all the Winter, and are in good State and flourishing, though grafted on Plants that drop their Leaves in Winter; which plainly proves that the Juices rise upwards, in Winter, in those Plants that drop their Leaves, otherwise the *Evergreens* that are grafted on them would soon perish.

I believe by grafting the Variety of foreign Oaks on the *English*, we might make the Timber more firm and lasting, than it is in it's own Nature, when raised from foreign Acorns: For as the Crab Stock maketh the Wood of the Apple-Tree more firm and lasting, than that on the Apple-Stock, and the Peaches and Almonds, budded on Plums, are more lasting than those on Peach-Stocks; so by the contrary Rule, all firm Timber, grafted on spongy Stocks, would be made worse than it would be on it's own Bottom. For Example, If that which is called the *English Elm*, should be grafted on that which is called the *Dutch*, it would partake of abundance of the spongy Juices of the Stock, whereby the Timber would become unfit for the Purposes it is now used for.

The first Experiment, I have now to offer is made on the *New England Cedar*, or rather *Juniper*, grafted on the *Virginia*; and what is remarkable in it, is, That the Branch, which is grafted, is left several Inches below the Grafting, which Part continues growing as well as the upper Part above the Grafting.

The second is on the *Viburnum*, the Top of which being planted in the Ground, is become Roots; and the Roots being turned up, are become Branches. I find the Plant in as good State of growing as it was in it's natural State.

The third is on a Pear-Tree, which I enarched upon two Pear-Stocks, in *March* 17<sup>21</sup>/<sub>22</sub>. which is now in a good flourishing State with a Branch in Blossom, and receiveth no Nourishment but by the two enarched Branches, the Root being out of the Ground; and though it was done above two Years ago, it is now shooting Suckers out of the Root, which proveth that the Branches are as useful to support the Roots, as the Roots the Branches; and it is therefore no Wonder that so many Trees miscarry in planting, when there are no Branches left on the Head.

The fourth is on the Cedar of *Libanus*, grafted on the *Laryx*, which drops it's Leaves in the Winter; yet maintains the Cedar in as flourishing a Condition, as if it had been on a Tree that held the Leaves all the Winter; and the Part of the Graft, left below the Grafting, is in as good Health as the Part above it.

XX. In 1724, I had a Parcel of fresh *Coco-Nuts* from *Barbadoes*: *A Method of raising some exotic Seeds, which have been judged*  
Part of these Nuts I divested of their outer Coat, or Husk, and the other Part I left entire as I received them. Both these Parcels I planted in large Pots, filled with good fresh Earth, and plunged the Pots into



almost imposs-  
 ble to be raised  
 in England,  
 by Mr Phillip  
 Miller, No.  
 403. p. 485.

into a Hot-bed made with *Tanners-bark*; giving them gentle and frequent Waterings as the Earth in the Pots seemed to require; but had not one, out of the whole Number, which made any Attempt to shoot, as I could perceive; and upon taking them out of the Pots, I found they were rotten. About four Months after, I received another fresh Parcel which I treated in another Manner: From part of these I cut off the outer Coat or Husk, and the other Part I left intire as before: But supposing it was owing to my planting the other Parcel in *Pots*, that they did not succeed, I made a fresh Hot-bed (with *Horse-dung*) and covered it over with *fresh Earth*, about 18 Inches thick, in which I planted the Nuts: Observing as before, to supply it with *convenient Moisture*, as also to keep the Hot-bed in an *equal Temper of Heat* (which I was guided to do by a *Thermometer* graduated for the Use of *Hot-beds*); but with all my Care I had no better Success than before; not one of the Nuts making any Essay towards shooting. The Year following I had another Parcel of *Coco-Nuts* given me, which, considering my former ill Success, I planted in a different Manner. Having a Hot-bed, which had been lately made with *Tanners-bark*, and which was filled with Pots of exotic Plants, I removed two of the largest Pots, which were placed in the Middle of the Bed, and opening the *Tanners-bark* under the Place where the two Pots stood, I placed the two *Coco-Nuts* therein, laying them Side-ways, to prevent the *Moisture* (which might descend from the Pots) from entring the Hole at the Base of the Fruit, and thereby rot the seminal Plant upon it's first *germinating*. I then covered the Nuts over with the *Bark* two or three Inches thick, and placed the two Pots over them in their former Station. In this Place I let the Nuts remain for six Weeks; when removing the two Pots, and uncovering the Nuts, I found them both shot from the *Hole* in the *Base* of the Fruit, an Inch in Length; and from the other *End* of the Fruit were several *Fibres* emitted two or three Inches in Length. Finding them in such a Forwardness, I took them out of the *Bark*, and planted them in large Pots, filled with *good fresh Earth*, plunging the Pots down to their Rims in the *Tanners-bark*, and covering the Surface of the Earth in the Pots half an Inch thick with the same: Soon after which the young Shoots were above two Inches long, and continued to thrive very well. I have communicated this Method since to some of my Acquaintance, who have tried it with the same Success and if the Nuts are fresh, scarce any of them miscarry. This led me to try if the same Method would succeed as well with other *hard-shelled, exotic Seeds*, which I could not, by any Method I had before tried, get to grow, as the *Bonduc*, or *Nickar-Tree*; the *Abrus*, or *Wild Liquorice*; the *Phaseolus Brasiliensis frutescens lobis villosis pungentibus maximus Hermannii*, or *Horse-eye Bean*; with several others; and I have found it both a sure and expeditious Way to raise any Sort of *hard-shelled Fruits, or Seeds*. For the *Heat and Moisture* (which are absolutely



absolutely necessary to promote Vegetation) they here enjoy in an equal and regular Manner; the *Tanners-bark* (if rightly managed) keeping to near an Equality of Heat for six Months, and the *Water* which descends from the Pots, when they are watered, is by the Bark detained from being too soon dissipated: which cannot be obtained in a common Hot-bed, the Earth in such being worked away by the Water, and thereby leaving the Seeds often destitute of Moisture. Some of these Seeds I have had shoot in a Fortnight's Time; which I am informed, would not have so done in a Month in their native Soil and Climate. I have also found this to be an excellent Method to restore Orange (or any other exotic) Trees, which have suffered by a tedious Passage, in being too long out of the Ground: Infomuch that I recovered two Orange-trees which had been ten Months without either Earth or Water.

XXI. 1. In September last I placed some Bulbs of *Tulips*, and other Flowers, in Water as the Figures represent; at which Time I put into each Glass two Grains of *Saltpetre*. These Glasses I kept in my Study, sometimes on a Shelf, at other times before the Window. In a Fortnight's Time I begun to find that they struck new Roots; the latter End of November they put forth Leaves, and in January they all flowered, as well as if they had been on a Garden-bed; whereas in Gardens we seldom see in Sweden, *Tulips*, before the latter End of May, and this Year they are later, the Ground being yet covered with Abundance of Ice and Snow.

Though these Experiments seem to be calculated for nothing but Delight, yet I think they have furnished me with some Lights, as to the Rise of the Sap in Plants.

2. The Glasses marked Numb. 1, were Roots of a *Hyacinth*, commonly known by the Name of *Pulchra*. Numb. 2. were Roots of the common *Oriental blue Hyacinth*. The Flowers of these were not so large as they are commonly produced when planted in a Bed of Earth; but this was occasioned by the Bulbs dividing into several Off-sets, each of which are as so many different small Roots, sending forth Stems and Leaves. Numb. 3, was a Bulb of a *Tulip*, which though placed on the Glass of Water at the same Time as the *Hyacinths*, yet was not likely to flower in a Month. Numb. 4, was a Root of *Narcissus*. This was also as backward as the *Tulip*, though put upon the Water at the same Time with the *Hyacinths*. These Roots were placed upon the Glasses the Beginning of November last; at which Time I put them into a Green-House, where the Air was kept constantly in a temperate Warmth. The Glasses were filled with common *Thames Water*, so near to the Top, that when the Bulbs were placed upon the Glasses, it might be about a quarter of an Inch below the Bottom of the Bulbs. Into those Glasses marked Numb. 5, I put a small Quantity of common Garden Mould, to try whether that would forward their Flowering, or encrease their Strength: But I

*An Account of Bulbous Plants flowering much sooner when their Bulbs are placed upon Bottles, filled with Water, than when planted in the Ground, by Mr Triewald, F. R. S. No. 418. p. 80.*

*Fig. 116, 117.*

*Experiments, relating to the same Subject, by Mr Philip Miller, F. R. S. No. 418. p. 81.*



found that all the Roots which were placed on those Glasses, into which the Earth was put, were at least a Fortnight later than the others before their Fibres were emitted, and their Progress has been since much slower. I also observed that the Water, in those Glasses where the Earth was put, did not waste above half so fast, as it did in those Glasses where there was none; which, I conceive, might be occasioned by the terrestrial Matter mixing with the Water, and so rendered it thicker, and less capable of being attracted by the Plants or evaporating by the Heat. And from those Glasses, where the Bulbs did not exactly cover their Necks, the Water evaporated much faster than from those where the Bulbs did entirely cover the Tops of the Glasses, so as to leave no Vacuities round them.

In about a Month after the Roots were put upon the Glasses of Water they began to put out their Fibres into the Water; but they did not begin to put forth their Leaves, until their Fibres were extended all over the Glasses, and were almost as full grown as at present. When their Leaves began to appear, the Buds of the *Hyacinth-Flowers* were soon visible, and in about three Weeks Time were fully blown. The *Tulips* and *Narcissus's* being much backwarder than the *Hyacinths* (as they always are when planted in a Garden) these should always be placed upon the Glasses of Water six Weeks or two Months earlier in the Season than the *Hyacinths*, when they are designed to flower at the same Time; and the *Præcoces* (or early blowing) *Tulips* should always be chosen for this Purpose.

By this Method a Person who has not a Garden, may have some of these Flowers growing in his Chambers, where, if they are not kept too close from the Air, or in a Place too warm, they will flower almost as well as in a Bed of Earth, provided the Roots are good, and are every Year renewed; especially the *Tulips*, because they every Year form new Bulbs, the old ones being always exhausted in nourishing the Leaves and Flowers, a new Bulb is annually produced by the Side of the Flower-stem. The *Hyacinths* I have observed to flower two Years successively upon Glasses of Water; but their Flowers were very weak the second Year. So that it is much the better Way to have fresh Roots every Year.

Of the Smallness of the Alpine Plants, by Dr Scheuchzer F. R. S. No 406. p. 593.

XXII. They become less and less, in proportion as the Mountains, upon which they grow, rise higher. Whether this be owing to the Sharpness and Purity of the Alpine Air, or the decreasing Pressure of the Atmosphere, which is far less upon Mountains than in Valleys and lower Countries, or to a Want of a sufficient Quantity of subterraneous Heat, to push the Nourishment into the Roots and Vessels of the Plants, or rather to a joint Concurrence of these and other Causes, would require a more leisurely Consideration. The Thing itself is an indisputable Matter of Fact, and it extends also to Trees and Shrubs, which become smaller, as they grow higher. Nay, what is still more remarkable, no Trees will grow beyond a certain Height, which



Fig. 112.



Fig. 116.

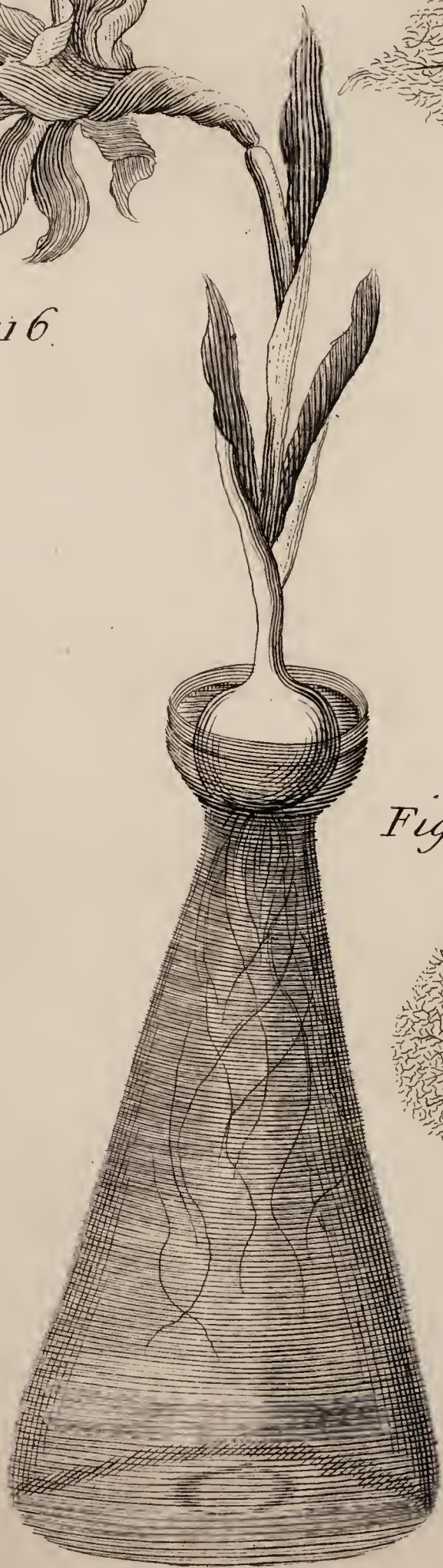


Fig. 113.

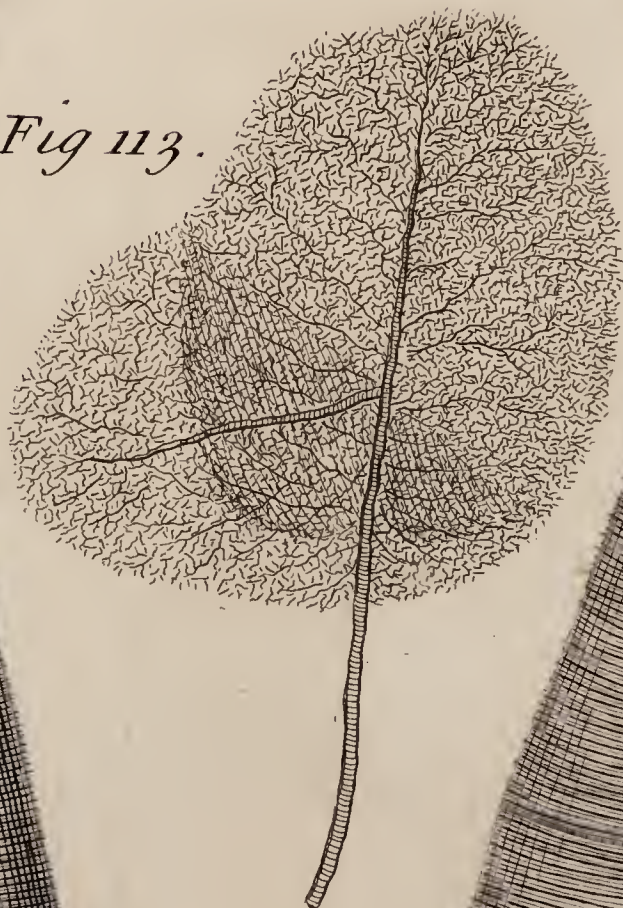


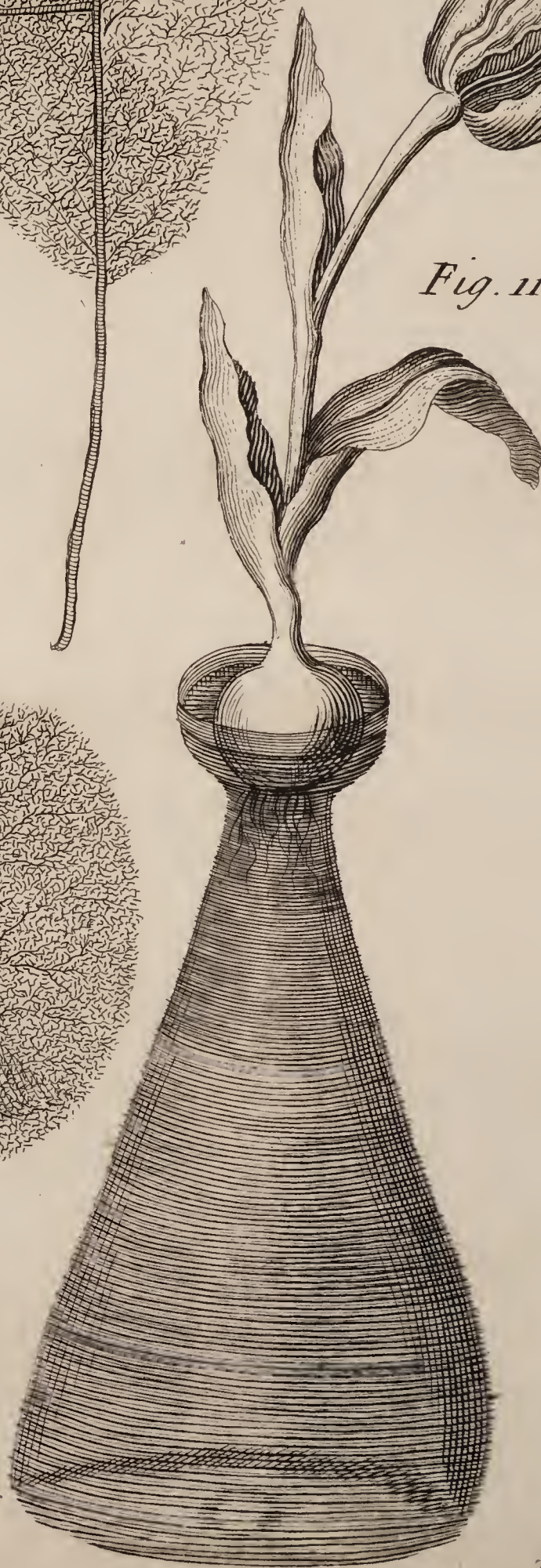
Fig. 114.



Fig. 115.



Fig. 117.









which is the Reason why the Tops of Mountains appear so bare and naked, if viewed at a Distance, though a curious Traveller shall not fail meeting upon their rich Pastures with an agreeable Variety of beautiful Plants. The Height, where the Trees cease to grow, hath been found, by Barometrical Observations, nearly to be the same in divers Parts of *Switzerland*. Otherwise, the Smallness of the Alpine Plants is abundantly compensated by the Richness of their Virtues, which are, as it were, purposely centred there into so narrow a Compass.

XXIII. 1. The *Oxyoides* is a Family of Plants, whose Flower and Fruit are altogether like those of the *Oxys*; that is, the Flower is compleat, regular, polypetalous and hermaphrodite; containing the Ovary, which afterwards becomes, as in *Oxys*, a five-cornered Fruit, divided into five Cells, filled with small Seeds; each of which is covered by a Membrane, like a Hood, which opens, when ripe; and by an elastic Motion, makes the Seed leap out.

*A new Family of Plants called Oxyoides, by Mons. Garcin. Translated from the French, by John Martyn, F. R. S. No 415. pag. 377.*

The true Characters by which it is distinguished from the *Oxys*, are, that the Leaves are disposed by Pairs along a Rib, without being terminated by an odd one, which makes them entirely resemble those of the *Tamarind*. That these Leaves are all gathered together, in an Umbel, on the Top of a naked Stalk: That they are not in the least Degree acid, and that they shew as great a Sensibility, on being touched, as the Species of *Mimosa*.

The Species of this Genus are,

- I. *Oxyoides Javanica, sensitiva, caule rubescente, hirsuto flore luteo, Fig. 118 minore.*
- II. *Oxyoides Malabarica, sensitiva, caule viridi, glabro altiore, flore Fig. 119 majore.*

The first usually grows to the Height of half a Foot. It is composed of a naked Stalk, Ribs of Leaves, and Pedicles of Flowers. Each of these Parts is of equal Length, and usually three Inches, when they are at their full Growth; and the whole is disposed in an Umbel.

*Description of the first Species.*

The Root, which is almost as long as the Stalk, runs straight down and sometimes obliquely into the Ground. It grows taper from it's Neck, which is of the same Thickness with the Stalk. It is set with small Fibres, a little waved and white, and giving Rise to other pretty short Filaments. The whole Root is whitish.

The Stalk arises sometimes straight, and sometimes crooked; sometimes wrinkled, and sometimes plain throughout it's whole Length, pretty downy, or rather hairy, and always reddish in some Places. It is from a Line and a half to two Lines thick towards the Top, and usually something less towards the Bottom. This Stalk, which forms a kind of Button,



*A new Family of Plants called Oxyoides.*

or little Head, at the Top, gives Rise at that Place to all the other Parts of the Plant; that is, to the Ribs of the Leaves, and the Pedicles of the Flowers; which makes the whole Tuft resemble an Umbel.

The Ribs of the Leaves, which grow from the Top of this Stalk, go on encreasing till they equal the Length of the Stalk. They are about the Thickness of the treble String of a Violin, and equal throughout their whole Length. They are a little downy like the Stalk.

The Leaves, which grow by Pairs, occupy two thirds of the Rib; that Part which is next the Stalk being naked. The first Pair of Leaves is the least, and the last Pair always the largest. These are commonly half an Inch long, and the smallest are not above half the Size of the largest. These Leaves grow so near the Rib, that they seem to have no Tail. Their Base is always the broadest Part of the whole Rib, and always parallel to the Rib: The rest of the Leaf bends itself a little forwards. The Middle of their Length is usually their narrowest Part, and from thence they are gradually enlarged, and rounded at their Extremities. The Bases of all the Pairs are almost of the same Bigness, except the last, which has the Breadth on one Side only of the little Nerve, which traverses the Leaf, to avoid incommoding itself with it's Neighbour but to make Amends, the Leaves of this Pair are broader than the others, a little below their Extremities, especially outwards. They are all traversed lengthwise by a fine Nerve, or Thread, always bent like the Leaf on the Side of the last Pair. They are of a lively Green on the Inside, and a little whitish on the Outside. Their Plain is garnished with a great Number of very slender Threads, almost imperceptible, but parallel, which grow also by Pairs, and are placed at acute Angles with their little common Nerve, and grow smaller at the Edge of their Leaf. In short, their Position and Figure come pretty near to those of the *Tamarind*. The Number is usually from eight to ten Pairs, and they are as sensible on being touched, as those of the Species of *Mimosa*. They shut themselves up at Sun-set, as it were to sleep, after the same manner with the Leaves of the *Tamarind*. The Ribs are in Number from two to three Dozen; and the Pedicles of the Flowers are about a fourth Part fewer in Number: they appear of different Lengths, because the shortest are the youngest, but at last they usually grow to almost the same Length with the first. The opening of the Leaves is performed almost after the same manner with that of the Top of the Spikes of the Species of *Heliotropium*, unrolling like the Tail of a *Scorpion*. The Ribs and the Pedicles are a little hairy, as well as the Stalk. The Pedicles are of the same Thickness with the Ribs.

The Flower, though it seems to be monopetalous, is not so, any more than the Species of *Oxys*, which seem to be so too: Otherwise the Principles of Mons. *Vaillant* would be false, who has laid it down



down as a Rule, that in all monopetalous Flowers the Chives grow from the Sides of the Flower. And that those which grow from the Base of the Embryon, or rather from the Ovary, are always poly-petalous. In short, if we examine them nicely, which no one has done till now, we may observe, that these Flowers have no *Anus* at the Base, but that the Petals, which are always five in Number, have their Bases separated very distinctly one from another; and though they are re-united about the Middle, which makes them look as if they were of one Piece, yet they may be separated without tearing.

The Petals are equal, they are from 3 Lines to  $3\frac{1}{2}$  long, and towards the Extremity about a third Part as broad as they are long. They are lightly cut in like a Heart at their Extremities. They are of a Lemon Colour, paler or deeper, according to the Moisture or Heat of the Season. Each of them has a small Streak running through their Middle lengthwise. They are covered by their Empalement about two Thirds of their Height, and from thence they open in Form of a Bell. They are very tender, and last but the Space of one Morning.

The Empalement is one-leaved: It is two Lines high, and the half of this Height makes the Thickness of it's Base. It divides a little below the Top into five Lobes, very sharp at their Extremities. It is pale-green, regular, and a little hairy.

The Chives grow from the Base of the Embryon, being twice the Number of the Petals, five of them being higher than the other five. The highest reach up to about the Middle of the Petals. Their Summits are of the same Colour with the Petals, and the Chives of the same with the Empalement, or a little brighter.

The Ovary is very small and round, but a little furrowed into five Ribs, the Diameter of which is about one Third, or almost half a Line. It is crowned by five Teeth, which form the Body of the Style.

This Ovary afterwards becomes a dry Fruit, of an oval Form, starred with five Furrows, of which the least Diameter is about one and a half or two Lines. This Fruit is divided into five Cells, and opens at the Top when ripe, and then expands itself by little and little to it's very Base, and discloses small, round Seeds, lodged four together in each Cell. They are each of them covered with a little Hood, or very fine Membrane, which on the Encrease of the Bulk of the Seed, opens itself with Violence, and throws it on the Ground. The Colour of the Seed pretty nearly resembles that of *Psyllium*.

Each Pedicle, during the Time of it's Encrease, continually puts forth new Buds, and new Flowers, in the same manner as the Stalk continually puts forth at the Top new Leaves and new Pedicles. The



*A new Family of Plants called Oxyoides.*

Number of these Buds is usually five or six at the Top of each Pedicle enlarged into a Head. These Buds grow, encrease and expand themselves one after another, which is the Cause that this Plant, when once it begins to flower, puts forth new Flowers every Morning, which are quite vanished in the Afternoon. The little Bunches of Buds, each of which adorns a large Pedicle, are encompassed with little Points, which compose a kind of common Empalement. The little Pedicle, which is proper to each Flower, is slender, and a full Line long, so that it's Length is equal to the Diameter of the Empalement.

The Diameter of the Flower, when it is most expanded, is four Lines.

The Petals make the Empalement expand itself a little: but when the Flower is faded, the Lobes of the Empalement draw together, and form a pyramidal Body; but when the Ovary grows bigger, and becomes the Fruit, the Lobes of the Empalement expand again without changing their Shape; because the Body of this Empalement encreases it's Diameter by the Effort which the Fruit makes within it.

This Plant is very sensible of the least Cold: It loves warm and moist Places. It is found in the Island of *Java*, and probably in the other Islands of the *Sonde* and the *Moluccas*. When one touches it's Leaves, they close immediately, and open again by little and little. The more they are warmed by the Sun, whilst their Soil is moist, the more impetuously they close against one another. The *Portuguese Indians* call it *Dormidera*, because, on being touched, it seems to sleep, by shutting up it's Leaves; or else, because some among them think it procures Sleep by being put under the Ear, as I have seen practised. The Leaves of this Species have no Acidity in their Taste, and give but a faint Tincture of Red to the blue Paper.

I thought this Plant curious and rare enough to be communicated to the curious *English* Botanists. I had the Pleasure to see a little while ago, in Dr *Blair*, that the Flower of the *Oxys* was pentapetalous.

*The Flower of the Oxyoides.*

Fig. 120.

Fig. 121.

Fig. 122.

Fig. 120. The Empalement. Fig. 121. The Flower, the Petals of which are joined together. Fig. 122. A Petal apart.

*A Remark by*  
John Martyn.  
*F.R.S.* No.  
415. p. 384.

2. We are obliged to Monf. *Garcin* for his curious Description of this Plant, by which it's Genus is determined. It is however by now means a new Species, having been described long ago by *Acosta*, and other Authors, under the Name of *Herba viva*. I have seen a fair Specimen of it in Sir *Hans Sloane's Hortus Siccus*, with which Monf. *Garcin's* Figure



Figure agrees very exactly. It was the first Sensitive Plant known in *Europe*, and very different from those which are now brought from *America*, and cultivated in our Gardens under that Name.

XXIV. Almost all the Writers of Botany have looked on this Family as a Tree, on account of it's Bigness, though it is tender, spungy, membranous and succulent, not at all hard or woody. It's Stalk is slender and supple, not able to keep itself upright, without a great Number of thick, membranous Sheaths, which cloath it's whole Bulk, and defend it from the Injuries of the Weather. Besides, this Plant being annual bears Fruit but once, and then by Degrees perishes.

*Remarks on  
the Family of  
Plants named  
Musa, by Mr  
Garcin. Tran-  
slated by the  
same, No.  
415. p. 384.*

Trees, on the other Side, which are ligneous, hard and perennial, bear Fruit several times. The Bigness then of a Plant does not seem to be a Character sufficient, to distinguish a real Tree from a Plant that is not one.

Again, the same Botanists have placed the *Musa* in the *Palmaceous* Class, which are all Trees, perhaps on account of this Plant's having but one Stalk, without any Branches; and because the great Leaves at the Top of it divide, when they grow old, in such a manner as to resemble, in some Degree, a Sort of *Palm*.

Having had an Opportunity in the *Indies* to consider this Plant better, I soon found that it justly belonged to the *Liliaceous* Tribe. It is known that the *Liliaceous* Plants have several Characters, which distinguish them very well. Their Roots are either bulbous, tuberous, or consisting of thick, fleshy Fibres: Their Leaves involve the Stalk, more or less, at their Bases. The Substance of their Flowers is filled with silver Spangles; and lastly, their Fruits are always divided into three Cells. The *Musa* has all these Characters. *Labat* says in his Travels, that the Root of this Plant is a thick Bulb, round and massy, emitting Fibres. *Marcgrave*, who has given a full Description of this Plant under the Name of *Pacoeira*, has observed, that, at it's first appearance, it sends forth two or three Leaves, rolled up like a Horn, which unrol themselves, and grow after the Manner of the *Cannacorus*. And, according to my Observation, the Fruit in all it's Species, is constantly divided into three Cells which is sufficient to shew, that it is a true *Liliaceous* Plant.

As *Marcgrave*, and the Authors of the *Hortus Malabaricus* have largely described this Plant, I shall content myself with only giving a Definition of this *Genus*, to make it better known.

The *Musa* is a *Liliaceous* Plant, with a monopetalous, irregular Flower, incompleat and hermaphrodite, composed of a Tube, which is filled with the Ovary, and a Pavillion divided into several Lobes, and forming a kind of Mouth. The Ovary, which adheres strongly to the Tube, is triangular, and crowned with five Chives, which grow from the Sides of the Flower: it has also a Style, which is terminated by a little Head. It afterwards becomes a soft, angular,



long, crooked Fruit, something like a *Cucumber*. This Fruit, when ripe, is fleshy, and divided into three Cells, filled with a mucilaginous Pulp; under which the Seed is placed along a *Placenta*, which serves as an *Axis* to the Fruit.

This Seed is small, round, edged with an almost imperceptible Leaf. The Flowers grow at the End of the Stalk, in Knots disposed in a Spike. Each Knot is loaded with two Rows of Flowers, covered with a membranous, hollow, thick, oval Covering, which serves them for a common Empalement. In the *Hortus Malabaricus* there are three Plates, which give a good Representation of the Plant, it's Flower, and it's Fruit; but I have observed three Defects in them: 1. The Flower is not represented in it's most perfect State, but almost withered, and so it's Pavilion too much cleft, which makes the Flower seem tetrapetalous; for the Flowers of these Plants divide when they are old, as well as the Leaves. 2. The three Cells are not shewn distinctly, in the transverse Section of the Fruit. 3. That the Seed is not represented at all.

This Family, comprehends about twenty-five Species, known to the *Indians*, the Differences of which are usually taken from their Fruits. This Plant does not perish before it has ripened it's Fruit whence it might last longer in a temperate Climate, cool enough to retard it's Fruit.

The Bark of the Fruit is formed of the Tube of the Flower; and the Lobes dry away during the growth of the Fruit.

Fig. 123.

Fig. 124.

Fig. 125.

Fig. 126.

Fig. 123. The Fruit of the *Musa* half stripped of it's Bark. Fig. 124. cut through the Middle. Fig. 125. cut transversly, distinguishing the three Cells and the Seeds.

Fig. 126. Another Species of *Musa* cut transversly, represented in the *Hortus Malabaricus*, but having the Cells better distinguished here. The six black Points are the Seed.

*A Method of  
discovering the  
Virtues of  
Plants by their  
external  
Structure, by  
Patrick Blair  
M.D. F.R.S.  
No. 364. P.  
30.*

XXV. I cannot enough admire the Judiciousness and Sagacity of the Ancients, who, without any of those means made use of by the Moderns, have handed down to us such an account of the Virtues of those Plants, which are more particularly dedicated to Uses in Physic, that all the laborious Endeavours of their inquisitive Successors, have never been able to outdo them. It must have been a long Tract of Experience, which enabled *Dioscorides* and *Theophrastus* to collect and receive from their wise Ancestors, such a lasting Catalogue of the Virtues of Plants, as scarce any thing has been added to even to this day. The Royal Academy at *Paris*, has been at great pains to find out the Virtues of Plants by the Chymical Analysis, and several other Experiments, of which we have the Abstracts in *Tournefort's Histoire des Plantes aux environs de Paris*, and *Tauvry's Traité des Medicaments*: But these laborious Endeavours only serve to confirm what the Ancients advanced, without any new Discovery. For *Tournefort*, after having made the Experiments with the *Tournefort* and



Fig. 118.



Fig. 123.

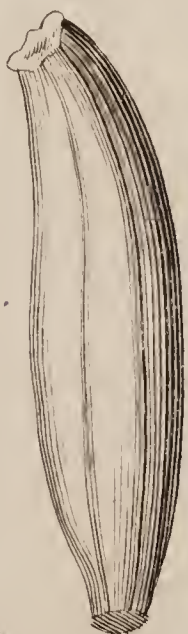


Fig. 124.



Fig. 125.



Fig. 126.

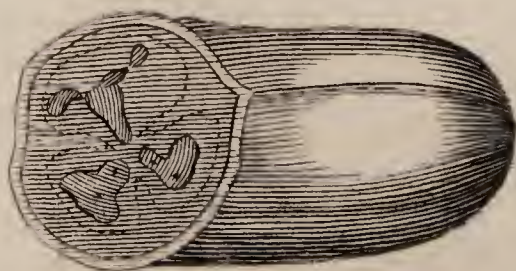


Fig. 121.



Fig. 122.



Fig. 120.



Fig. 119.









and blue Paper, and given an exact Account of the several active Chymical Principles, which are observ'd in such and such a Plant, usually concludes. *Therefore, 'tis not surprising if it is endowed with such Virtues*; which is nothing but giving a Reason why the Ancients believed they were good for such a Distemper.

The Means used by our Forefathers to discover the Virtues of Plants, and their Use in the several Diseases, as they were the most simple, so they are most assisting at this very time. It seems they narrowly considered their *Facies externa*, and thus concluded; If such a Plant partake of such Virtues, such another so very like to it, must be endowed with the same, v. g. *Apium* and *Fœniculum* have the same manner of flowering; both produce their Seed after the same manner; their Roots are both alike, being long, white, straight, carnous, &c. Therefore since a long Tract of Experience, handed down by Tradition, shews that such a Plant has such Virtues, such another like it must have the same. Thus we find *Apium*, *Fœniculum*, *Petroselinum*, all joined together, and prescribed as the opening Roots in the *Dispensatory*. This induced the Celebrated Dr *Herman* to lay down these general Maxims, *Quæcunque flore & semine conveniunt easdem possident virtutes*: And *Omnia semina striata sunt carminativa*.

Thus at the first view, without knowing the Characteristics so nicely as Botanists do, but only exactly observing the *Facies externa* of the Plant, when the Virtue of one Species is known, the Virtues of all the Congeners may be guessed at, if not fully determined.

The next simple Method of the Ancients, to discover the Virtues of Plants, seems to have been the Taste and Smell. Thus *Apium* and *Petroselinum* have a Taste resembling each other, therefore they are to be prescribed together. The Seeds of *Fœniculum* and *Anisum* have much the same Taste and Smell, and therefore both of them must be Carminative, &c. They had likewise recourse to the Temperament and Qualities, such as Hot and Dry, Cold and Moist, in the 1st, 2d, 3d, and 4th Degrees. But since the Taste is not always the same in one Person, and that different Persons have different Sensations; that, as being too much subjected to the different Tempers and Imaginations of People, is deservedly exploded.

I have lately composed a Compendious Scheme of all the Plants used in Physic; in which, that I might render it less liable to Objection, and not seem to introduce any Innovation in the Distribution, I have not so strictly observed the making their Characteristic Notes and Virtues agree, as the distributing them according to their Operations.

The first Distribution, is, by joining together all those which are prescribed under one Title in the Shops; such as the Opening Roots, Emollient and Capillary Herbs, Cordial Flowers, hot and cold, greater and lesser Seeds. In this I have not kept to the *Dispensatory* Catalogue, but have added several Congeners, that I might give a



## A Method of discovering the Virtues of Plants.

Specimen of what is proposed concerning the Virtues and Characters. Thus I have added *Cuminum* and *Meum* to *Fœniculum*; *Laurus Alexandrina*, and *Hippoglossum* to *Ruscus*; *Alcea* to *Malva* and *Althea*; *Bonus Henricus*, *Atriplex*, &c. to *Beta*, under the Title of *Oleraceous Emollients*; *Lingua Cervina*, *Polypodium*, &c. to the Capillary Herbs; and so on in the Cordial Flowers, and hot and cold Seeds.

I have, 2dly, distributed the Plants into such as are Altering and Evacuating. The Altering are divided into those that consist of Gross, and such as are said to consist of Tenuous and Subtile Particles. Those consisting of Gross Particles, are Astringent. Such as prevent Abortion and Ruptures, Stoppers of the *Fluxus menstruus immodicus*, *Fluor Albus*, *Diarrhœa*, *Dysentery*; good in Burnings, Bruises, Cancers, spitting of Blood. Gross Medicines are Narcotics, Vulnerary, good for Scrophulous Tumors, Squinancy, Refrigerators.

Plants consisting of subtile Particles, are Aperient; such are all Ophthalmics, Arthritics, Nephritics, Lithontriptics, Diuretics, Hydropics. They are also Pectoral, Anti-Apoplectic, Paralytic, Hysterical, Hypochondriac. Provokers of Birth, Febrifuges, Scorbutics, Stomachics, Vermifuges.

The Evacuating Medicines are Emetic, or such as work upward; or Laxative and Purgative, such as work downwards. The Nutritive Medicines are the *Plantæ Cereales* and *Leguminosæ*.

It is here to be noted, that I have not inserted any Plant in this Table, but such as are indigenous in *Britain*, or are cultivated in *British* Gardens; and to render it still the more useful, I have added such particular Parts as are used in the Shops; viz. The Root, Herbs, Leaves, Tops, Flowers, Fruit, Nuts, Bark, and Wood.

Having thus reduced within a small Compass the most considerable Virtues of Plants, both General and Specific, and shewn the most easy, simple, and natural Method of discovering them, I would not be so far misunderstood, as if I were averse from using other Experiments in finding them out. On the contrary, I could heartily recommend another Method, hitherto much neglected, and which I am convinced would be of great Use, if accurately gone about; and that is, their Infusion in different Liquors, in order to find out the proper *Menstruum* for extracting their more useful Parts.

Every Physician is sensible, that there are several Simples, and these specific too, which adhibited in Substance, are of great Efficacy; whereas, if their Contexture is dissolved, their Parts can never be so re-united as to produce the same effect. Thus *Cortex Peruvianus* is never so effectual, as when given in Powder. That there are others which will communicate their useful Particles when infused, to one Liquor and not to another; and that the same Substance will impregnate two Liquors diversely, according to the different *Menstruums*. *Lemery* advises to infuse *Opium* in Water and Spirit of Wine, separately



separately; and after to mix both Infusions together, in order to make the *Laudanum* or Extract; wisely considering, that the Water will be impregnated by the more soluble saline Particles, whereas the Spirit will only imbibe the more resinous; for Water is the proper *Menstruum* for a saline Substance, which will not dissolve in Spirit of Wine; this rather hardening and preserving it from being dissolved, either by Air or Water. Thus the most convenient way to preserve the volatile Salt of Animals, is to keep it in Brandy; and every one knows, that Water immediately dissolves Sugar, which Brandy will not do. Therefore *Senna* will impart it's purgative Quality to Water or Ale, having it's saline Particles more disengaged; but the purgative Virtue of *Jalap* consisting in it's Resin, requires Wine or Brandy for the *Menstruum* or Dissolvent.

Therefore, in my Opinion, a most proper Means to find out the Virtues of Plants, is to have recourse to the proper *Menstruums*. A Simple may be infused in Rain Water, Snow Water, or pure Fountain Water; if it's Texture is loose, and it abound with saline Particles, those pure Elements will be impregnated by it; but if the Texture be more compact, firm and solid, if it's Particles are more fixed, Mineral Waters; or by the addition of a proportional quantity of the fixed Salt of a Plant, a proper *Menstruum* may be prepared. And next to the adhibiting of the Bitters in substance, such as Wormwood, Gentian, and Camomile Flowers, this is the most convenient way of administering them; not but their Tincture extracted by Brandy or Wine may do very well; But since they abound very much with a fixed Salt, a great deal of their Virtue may be communicated to a less spirituous Liquor, when a more spirituous will not extract it. The proper means to know which *Menstruum* will best extract the more useful parts of any Simple, or rather suspend it's more solid Particles, is to use the Hydrostatical Ballance; when having weighed the *Menstruum* before Infusion, and after the *Materies* has been infused for some time, it will soon be observed by the Augmentation of the Weight, how far the *Menstruum* is impregnated, and which is the most proper Dissolvent. The properest Method of adhibiting the fixed Simples, if not in Substance, is by Decoction, Infusion, or Tincture. (It is called Infusion, when the *Menstruum* is either Water, Ale, or Wine; but a Tincture, when Brandy is employed;) and the best way to obtain the useful Particles of volatile, tenuious, or subtile Substances, is by Distillation. These may indeed be proper Ingredients for an Infusion or Tincture. But there are a great many fixed Substances as improper for Distillation, as the Volatile are improper for Extracts.

XXVI. I. A very extraordinary Accident that fell out at Dublin, some Months ago, has discovered to us a most dangerous Poison, which was never before known to be so, though it has been in frequent Use among us. I mean the Simple Water, distilled from the

*Laurel Water*  
a dangerous  
Poison, by  
T. Madden,  
M. D. N<sup>o</sup>.  
418. p. 84.

Leaves



*Laurel Water a dangerous Poison.*

Leaves of the *Lauro-cerasus*. It is at first of a Milky Colour, but the Oil which comes over the Helm with it, being in a good Measure separated from the Phlegm, by passing it through a Flannel-Bag, it becomes as clear as common Water.

It has the Smell of the bitter Almond, or Peach-Kernel, and has been for many Years in frequent Use among our Housewives and Cooks, to give that agreeable Flavour to their Creams and Puddings. It has also been much in Use among our Drinkers of Drams and the Proportion they generally use it in, has been one Part of *Laurel-Water* to four of *Brandy*.

Nor has this Practice (however frequent) ever been attended with any apparent ill Consequences, till some Time in Sept. 1728, when it happened that one *Martha Boyse*, a Servant, who lived with a Person that sold great Quantities of this *Water*, got a Bottle of it from her Mistress, and gave it to her Mother *Anne Boyse* as a very rich Cordial.

*Anne Boyse* made a Present of it to *Frances Eaton* her Sister, who being a Shopkeeper in the Town, gave about two Ounces of it to a Woman called *Mary Whaley*, who had bought some Goods of her.

*Mary Whaley* drank about two Thirds of what was filled out, and went away. *Frances Eaton* drank the rest. *Mary Whaley* went to another Shop to buy somewhat else, and in about a quarter of an Hour after she had drank the *Water* (as I am informed) she complained of a violent Disorder in her Stomach. She was carried Home, and from that Time lost her Speech, and died in about an Hour, without Vomiting, or Purging, or any Convulsion.

The Shopkeeper, *Frances Eaton*, sent Word to her Sister *Anne Boyse* of what had happened, who came to her upon the Message, and affirmed, that it was not possible the Cordial (as she called it) could have occasioned the Death of the Woman; and to convince her of it, she filled out about three Spoonfuls, and drank it. She continued talking with *Frances Eaton* about two Minutes longer, and was so earnest to persuade her of the Liquor's being inoffensive, that she filled out two Spoonfuls more, and drank it off. She was hardly well seated in her Chair, when she died, without the least Groan or Convulsion.

*Frances Eaton*, who, as was before observed, had drank somewhat above a Spoonful, found no Disorder in her Stomach, or elsewhere; but to prevent any ill Consequence, took a Vomit immediately, and has been well ever since.

*Mary Whaley* was buried without being examined by any one, that I can find, except the Coroner. I went to see *Anne Boyse* about Twenty-four Hours after her Death, but could not prevail to have her opened. She was about sixty Years old; her Countenance and Skin appeared well coloured, and her Features were hardly altered,



so that she looked like one asleep. Her Belly was not swelled, nor had she any other external Mark of Poison.

This Accident brought into Discourse another of the like Nature which happened about four Years since in the Town of *Kilkenny*. A young Gentleman, Son to Mr — *Evans*, an Alderman of the Town, mistook a Bottle of this *Laurel Water*, for a Bottle of *Ptisan*. What Quantity he drank is uncertain, but he died in a few Minutes complaining of a violent Disorder in his Stomach. This Affair was not much regarded at that Time, because he laboured under a Distemper, to which, or to an improper Use of Remedies, his Death was attributed by those about him.

To satisfy myself farther as to the Effects of this Poison, I made some Experiments, in Conjunction with a few of my Friends, an Account of which follows.

I. *Oct.* 3, 1728, We gave a large Setting-Dog three Ounces of *Laurel Water* by the Mouth. In three Minutes he began to be strongly convulsed. His Convulsions continued about five Minutes; after which I untied him. He then fell into a most violent Difficulty of Breathing, which lasted about eight Minutes, and abated gradually; upon which he endeavoured to raise himself, but could not.

I tied him down again, and gave him an Ounce and an half more, upon which he sunk at once, and without any Return of his Convulsions, or Difficulty of Breathing, expired in two Minutes.

Upon opening the Stomach, I found in it the whole Quantity of Water which he had taken; it's Surface was covered with Froth, but it was not otherwise altered in it's Colour, Consistence, or Smell. The Inside of the Stomach was not at all inflamed, nor was there any visible Alteration in the *Tunica Villosa*.

The Veins of the Stomach, all the *Mesaraic* Veins, and likewise the *Vena Cava*, were much distended with Blood; the *Arteries*, on the contrary, were remarkably empty. The *Liver* and *Gall-Bladder* were no Way altered. The *Kidneys* were unusually full of Blood, and appeared of a bluish Colour, almost as deep as that of the Violet Plumb. Upon making an Incision into one of the *Kidnies*, the Blood flowed in much greater Plenty, and was more fluid than usual. In the *Heart* there appeared nothing præternatural. The *Brain* was no way altered.

II. *October* 24, We gave an Ounce and a half of the same *Water* to a Bitch of a smaller Size. She was immediately let loose, and in two Minutes lost the Use of her Limbs. She attempted several Times to raise herself; and walk, but she staggered and reeled about, and then fell down. She repeated this without ceasing about five or six Minutes. At last she was violently convulsed, especially in the Muscles that extend the *Head* and *Spine*. About the Space of a Minute she



she had that Sort of Convulsion called the *Opisthotonos*, the Back of her *Head* being drawn almost to her *Tail*.

After this she vomited plentifully, and her Convulsions ceased. She then lay still for seven or eight Minutes, labouring for Breath (though not so violently as in the former Case) and foaming at the Mouth. We gave her an Ounce more of the Water; upon which her Difficulty of breathing encreased, and she died in two Minutes.

Upon opening the *Abdomen*, the *Thorax*, and the *Head*, we found every thing in the same State as in the former Instance.

III. *October 25*, We gave two Ounces of the *Water* to a Dog of the same Size with the former, which produced the like Appearances as in the foregoing Case. This Dog was dying half an Hour; for the Dose was not repeated, because he did not vomit up what he had taken. Upon opening him, we found every thing in the same State as in the former Instance.

IV. *October 26*, We gave two Drams and a half of the *Water* to a Dog of a middle Size, and immediately untied him. He then ran about the Room very briskly for about a Minute, and seemed to be no Way affected with it; yet he soon lost the Use of his Limbs. He often attempted to raise himself, and walk, but still fell down again before he had moved two Yards from the Place.

After this he vomited plentifully, considering that he had fasted 24 Hours, upon which he was seized with a Convulsion more violent than any of the former Dogs, especially in the Muscles that extend the *Head* and *Spine*. These Convulsions continued about eight or ten Minutes; upon their ceasing, he lay still, breathing deeply, though regularly and seemed to be asleep. In about ten Minutes he raised himself, took some Food, and walked about tolerably well. We left him, and returning after three Hours, we found him perfectly recovered.

V. *October 28*, We injected an Ounce of the *Water* into the *Intestinum rectum* of a strong Spaniel Dog, and let him loose. In the Space of two Minutes he began to lose the Use of his Limbs, and to stagger as the others had done. He was convulsed more violently than any of the rest, and chiefly in the Muscles of the *Neck* and *Spine*. The Muscles of his *Eyes* were strongly convulsed, which Appearance was not observed in the other Dogs. He foamed at the Mouth, yelled frequently, and breathed with more Difficulty than any of the rest. His Convulsions continued twenty Minutes; upon their ceasing he lay quiet, as though he slept, only that his *Eyes* were open. His Limbs were now grown perfectly paralytic.

We raised him up several Times, and set him on his Legs, but he did not attempt to use them. He continued in this Way about fifteen Minutes longer, and then was seized with another violent Convulsion, which in five Minutes put an End to his Life.

Upon



Upon opening the *Abdomen*, we found the Veins of the *Stomach* and *Guts* very much distended with Blood, as in all the former Instances. In the *Heart*, *Lungs* and *Brain*, there was no visible Alteration.

VI. *October 30*, We injected an Ounce and a half of the *Water*, diluted with three Ounces of common *Water* warmed, into the *Anus* of a small Bitch. Before we could untie her she was seized with Convulsions, and yelled much. She fell as soon as she was loosed, and never after endeavoured to rise. She had Convulsions, and great Difficulty of Breathing about two Minutes. She then lay still, with her Limbs stiff and extended, about three Minutes; during which Time her lower Jaw was convulsed, and pulled alternately to and from the upper Jaw, with a very quick Motion.

After this her Limbs became paralytic, and she gasped for Breath about two Minutes longer. She was quite dead in seven or eight Minutes from the Injection of the Clyster.

In the *Abdomen*, *Thorax*, and *Brain* every thing appeared as usual.

VII. *Nov. 2*, We injected half an Ounce of the *Water*, diluted with three Ounces of common *Water* warmed, into the *Anus* of a small Bitch. In the Space of four Minutes she began to breathe with Difficulty. We let her loose, but she was not able to stand, or walk without stumbling. The Muscles that extend the *Head* were convulsed, and her Fore-legs were affected for three or four Minutes with a *Tetanus*, but had no convulsive Motion. She vomited and purged plentifully. She did not yell, nor seem to suffer much Pain, nor did she lose her Senses all the Time. In half an Hour she recovered.

VIII. The next Day, we injected a Drachm of the *Water* into the external *Jugular* of the same Bitch. She was seized with Convulsions as violent as the former, before we could untie her. They lasted about five Minutes; after which she recovered gradually, and continued well.

IX. *Nov. 20*, We injected four Ounces of the *Water* by the *Anus*, without any Dilution, into a strong Dog of a middling Size. He was seized with Convulsions and Difficulty of Breathing, in less than two Minutes after the Injection. He fell to the Ground as soon as his Convulsions began, and never once attempted to rise; nor were his Convulsions in any Sort so violent, neither did they continue so long as in the former Instances. He bled at the Nose about four Spoonfuls. The Blood was of a very bright florid Colour, his Convulsions lasted about four Minutes; after which he became entirely paralytic, and died in three Minutes more.

We found the *Stomach*, *Intestines*, *Liver*, &c. in the same State as those abovementioned. Upon cutting about an Inch from the lower



Part of one of the Lobes of the *Lungs*, the Blood flowed from it in great Plenty, and appeared more florid and fluid than usual.

X. *Dec.* 14, We gave five Ounces of *Laurel Water* by Clyster to a Dog somewhat of the Size and Shape of the *Italian Greyhound*. He seemed at first to be no Way affected with it, but in about five Minutes he began to droop, and lose the Use of his Limbs. He did not once yell, or struggle, as the others had done, but sunk gradually, till he became at last entirely paralytic. He had not any Convulsion, except a kind of *Spasmus Cynicus*, a few Minutes before he died, which happened in half an Hour after the Injection of the Clyster.

Upon opening the *Abdomen*, we found the Veins much distended with Blood, as were also the Veins and Sinuses of the Brain.

XI. *Dec.* 19, We gave three Ounces of the Water in the same Manner to a Cur of the Lap-dog Size. He died in seven Minutes, without any Convulsion, except a *Tetanus* in the Muscles that extend the Head.

The *Lauro-Cerasus* being an Ever-green, and abounding with a warm essential Oil, we imagined that other Ever-greens might partake of the same poisonous Quality.

Accordingly we made Trial of a Water distilled in an *Alembic* from the Leaves of the *Yew-Tree*, so much talked of by the Ancients, and whose very Shade they supposed to be fatal to those who sat or slept under it.

XII. We gave three Ounces of this Water by Clyster to a very small Cur Dog, but he was not in the least affected with it.

XIII. We also gave, by the Mouth, two Ounces of a Water distilled from the Leaves of the *Bay-Tree*, to a young Spaniel, without any Effect.

XIV. We afterwards made an Experiment with the distilled Water of *Box-Leaves*, which had a very strong *Narcotic* Smell. We injected five Ounces of this Water, by the *Anus*, into a small Cur Dog, but he was no Way affected with it, though we kept him twelve Hours after the Operation.

XV. Being desirous to know whether the Virulency of *Laurel-Water* was owing to the Fire in Distillation, we poured warm Water upon some *Laurel-Leaves* bruised, and made a strong Infusion of them. We poured an Ounce of it down a Dog's Throat, half of which was supposed to enter the Stomach, and five Minutes after another Ounce was given in like Manner. The Dog seemed to be somewhat sick at his Stomach, but was soon as lively as ever. A few Minutes after this another Ounce was given to him by the Mouth of which we suppose a fourth Part to have been lost. He soon after stared, and trembled very much. In five Minutes another Ounce was exhibited, upon which he trembled as before, but in a little Time he appeared easy and lively.



Imagining that these small Quantities lost their Power, during the Intervals of giving them, in ten Minutes after his taking the former Dose, we poured down his Throat two Ounces and a half at once. He immediately tumbled on his Back convulsed, and tumbled over three or four times, but quickly returned to his Feet. He staggered, his Eyes stared, and he sat down like a Dog that is tired. At length he shut his Eyes, his Neck became extended, and we apprehended he was falling into Convulsions; but instead thereof he vomited a vast Quantity of indigested *Chyle*, in which appeared a great Portion of the Infusion; after which he seemed to be perfectly recovered.

XVI. In about twenty-five Minutes after this we gave the same Dog by the Mouth two Ounces of the Juice expressed from *Laurel-Leaves*, and in about ten Minutes more another Ounce was given him in the same Manner. In a few Minutes he began to lose the Use of his hinder Legs, but he quickly recovered them. Upon his taking another Ounce soon after the former, he fell into a great Difficulty of Breathing, and yelled much. After this he was seized with very strong Convulsions, which affected his lower Jaw and hinder Legs most remarkably.

In about the Space of five Minutes these Convulsions were succeeded by an entire Resolution of all the Limbs. He breathed with great Difficulty, and very slowly. No Appearance of Expiration. Sometimes we observed two Attempts at Inspiration without Intermision, or closing of the Mouth. At other times there was near the Space of a Minute between two Inspirations.

After this he was seized with a Trembling in his Limbs, and in about three Quarters of an Hour from his taking the last Ounce, he died without any Struggling, with his Tail extended.

There were several other Experiments made of the same Kind, by some Gentlemen of the Profession here, which corresponded exactly with the foregoing, excepting this one Circumstance, that they were of Opinion, that this Poison occasioned an Inflammation in the *Stomach* and *Guts*.

Towards clearing this Dispute, We, who thought otherwise, put together the following Hints, from which it appears that the Fact is not as they imagined, and that notwithstanding we find, upon an Animal's being killed by this Poison, the Veins greatly distended with Blood, yet there is not any Inflammation produced by it.

I do not know any thing that will illustrate this Matter better, than the Analogy which may be observed between the Convulsions occasioned by the Epilepsy, and those which are the Effect of *Laurel Water*.

For Instance, in the Epilepsy, the Body is universally convulsed, especially the Muscles of the *Neck*, the *Tongue*, the lower *Jaw*, and those of the *Arms*.



The Effect of these Convulsions is this: The *Heart* beats with unusual Violence and Frequency, the necessary Consequence of which is, that the Blood will be thrown in greater Plenty from the Arteries into the Veins. But because the Muscles compress the Veins more than the Arteries (whose Systole does enable them to overcome that Pressure) therefore the Blood, which is still pushed forward by the Systole of the Heart into the Veins, will be retained there by the aforesaid Pressure of the Muscles, and will return in a very small Quantity to the *Heart*.

For Example, the *Abdominal* Muscles being convulsed, press the *Stomach* and *Intestines* upon the *Vena Cava ascendens*, and likewise upon the *Vena Portæ*; by which Means the Blood, returning from the lower Extremities, is retained in those Vessels. Accordingly we see the visible and immediate Effects of this Pressure are the forcing out the Excrements of the *Bladder* and *Intestines*, and very frequently the *Profluvium Seminis*.

In like Manner the Pressure of the Muscles of the *Neck*, *Tongue*, and lower *Jaw* upon the *Jugular* Veins and their Branches, will not suffer the Blood to return to the *Heart* by the *Vena Cava descendens*.

To this we may add the Pressure of the *Diaphragm* and *Ribs* upon the *Lungs*, by which Means the Trunks of the *Vena Cava ascendens* and *descendens* are compressed at their Insertion into the *Heart*.

Hence follows that frightful Blackness of the Face during the Paroxysm, and the prodigious Swelling of the Veins of the Head, especially the Temporal.

The necessary Consequence of all this must be, that if the Convulsion lasts long enough the Man must die, on Account of the Blood being thrown out of the Arteries into the Veins, and not returning to the Heart. And I make no Question, that if such a Person was opened after Death, we should find the *Vena Cava*, the *Vena Portæ*, the Veins and Sinuses of the *Brain*, together with all their smallest Ramifications, very much distended with Blood, and the Arteries on the contrary almost empty.

But if the Epileptic Convulsion ceases before the Circulation of the Blood is entirely stopped, then all becomes calm again, the Pressure is taken off the Veins, the Blood returns to it's usual Course, and in a few Hours the sick Person is perfectly recovered.

And yet all this violent Convulsion of the Body, this prodigious Distension of the Veins, and Interception of the Course of the Blood passes without any Inflammation, as appears from the speedy Recovery of the sick Person: For if the Convulsion had occasioned an Inflammation, a Fever must necessarily have ensued, which would discover itself by manifest Tokens, and would require a much longer Time for it's Abatement.

Let us now observe the Analogy between these Appearances, and those produced by *Laurel Water*.



We find by Experiment, that an Ounce, or even two Drachms and a half, of *Laurel Water* will occasion more violent Convulsions than three Ounces, or even five of it. *Exp.* 4, 5 to 11. If therefore an Inflammation was the necessary Consequence of this Water being taken into the *Stomach* or *Guts*, the more violent the Convulsion is, the greater the Inflammation ought to be.

On the contrary we find, that the more violent the Convulsion is, the greater is the Probability that the Creature will recover. *Exp.* 4 to 7. And when it so falls out, the Manner is exactly the same as in the Recovery of an Epileptic Person. In a few Minutes the Creature becomes as brisk as if no such Thing had happened.

Now if an Inflammation was at all the necessary Consequence of this Poison, though the Creature recovers, yet there must be some Inflammation, greater or less, produced, which must occasion more violent and lasting Symptoms. But since none such appear, since the Recovery is so sudden and effectual, it is the strongest and plainest Argument, that there is not any Inflammation produced.

If the *Laurel Water* is administered to the Quantity of an Ounce or more, the Creature unavoidably dies in a few Minutes, and upon opening him the Appearances are these. Both the Trunks of the *Vena Cava*, and all the Ramifications of the *Meseraic* Veins are greatly distended with Blood. These Vessels are easily distinguished from the Arteries, not only by the Thinness of their Coats, but also by the Colour which the Blood exhibits to the Eye. Now I conceive that all Inflammations have their Beginning in the Arteries, and that they are produced, because there is no free Passage for the Blood into the Veins. But if once this Passage becomes free (as in this Case it surely is, for we find all the Veins distended with Blood beyond their natural Dimensions) the Inflammation is then at an End, the Cause which produced it being taken off.

Moreover, the Fact laid down, that the Veins are preternaturally distended with Blood, does necessarily conclude, that the Arteries are not distended with it, and consequently that there cannot be any Inflammation; for if the Quantity of Blood is encreased in the Veins, it must be proportionably diminished in the Arteries.

To what has been said, we may add the following Observation; *viz.* that if there was any Inflammation produced by this Poison, it ought to appear most remarkable on the Inside of the *Stomach* and *Intestines*, because of the immediate Contact it has with those Parts.

All other Poisons which occasion Inflammations in the *Stomach* and *Guts*, do first operate upon the Blood-Vessels, and corrode the Parts inflamed. They occasion Vomitings and Fluxes of Blood, which at length terminate in Convulsions.



One may very easily be deceived upon opening the *Stomach* of a Dog, and may mistake the Redness of the *Tunica Villofa* for an Inflammation.

The inner Coat of a Dog's Stomach is naturally of a ruddy Flesh-colour, and therefore of all domestic Animals a Dog has the quickest and strongest Digestion. Accordingly we see, that they swallow Bones, and digest them perfectly well; and although they are but half chewed when taken into the Stomach, yet they are at last reduced to as soft a Consistence as any other Part of their Aliment. It is for this Reason, therefore, that the Stomachs of Dogs are more plentifully supplied with Blood than those of other Animals; by which Means not only the muscular Force of the Stomach, but it's Warmth also, which is the principal Instrument of Digestion, is very much increased.

N. B. The 15th and 16th *Experiments* were communicated to me by Dr Stephens, a Fellow of our College of Physicians.

*An Antidote to this Poison, by Dr John Rutty. No. 418. pag. 100.*

2. *Bole, Vinegar* and *Milk* were given to a Dog which had swallowed some of the *Laurel Water*: The *Bole* and *Vinegar* were not observed to do much good, but the Dog which drank the *Milk* recovered without any bad Symptoms; but at that Distance of Time the Doctor could not recollect the Proportions that were given: He thinks a Pint of *Milk*.

*Experiments concerning the poisonous Quality of the Laurel Water, by Cromwell Mortimer, M. D. R. S. Sec. No. 420. pag. 163.*

3. I took a Peck of Laurel Leaves, and put them into an Alembic with three Gallons of Water, which I distilled in the common Way. The Fire at first being too hot, there came over an Oiliness with the Water, (1.) which made it appear milky, till about half a Pint had run: This tasted and smelt very strong like Apricock Kernels, as did the next Running, (2.), which was clearer. I kept the first Quart by itself; then I drew off another Quart, (3.) which was not near so strong in Taste or Smell, but rather resembled *Black-Cherry Water*: The Remainder was almost insipid. The Leaves after the Distillation looked brownish, were brittle, and tasted bitter without the Roughness or Apricock-Kernel Flavour, which they have while fresh.

In the Afternoon of the same Day I took a Mungrel Puppy, weighing two Pounds and an half, about sixteen Days old; it had sucked the Bitch in the Forenoon, but had now fasted six Hours. I took one Ounce of the third Water, and gave some of it to the Puppy, gradually by Tea-Spoonfuls, that it might the better swallow it. When it had taken half the Quantity, I let it go; it walked about pretty strongly for five Minutes, when it began to foam at the Mouth, and soon after vomited up some curdled Milk, and then discharged the *Fæces alvinæ*, after which the Sickness seemed to go off: I then gave it three Tea-Spoonfuls more; in ten Minutes it began to stagger, and draw it's hind Parts after it; it sat upon it's Breech, whined, and made several Efforts to vomit, but never brought any thing



thing up; and then again would walk about, and sit down and whine, and again seem to recover for about fifteen Minutes longer: Then thinking the second Water would dispatch it sooner, it seeming to be very uneasy, I took one Ounce and half of the second Running: I gave it first three Tea Spoonfuls, and set it down, when in two Minutes time it became strongly convulsed, put out the Tongue, and made strong Efforts to vomit, but to no Effect; it could not stand, but lay with it's hind Legs stretched out: Five Minutes after I gave three Tea Spoonfuls more, when it was stronger convulsed, rolled over and over several times, drew it's Head back to it's Rump, then lay on it's Side and panted much: About eight Minutes after, I gave it two Tea-Spoonfuls more and it had fresh and strong Convulsions, but kept lying on it's Side, and thus stretching out it's four Legs one after another, drawing in it's Flanks very quick; in fifteen Minutes more it died, being in all about an Hour from the first Dose.

An Hour after it was dead I opened it, and found all the Contents of the *Abdomen* well; the Stomach was distended with Wind, it appeared empty of Milk, but full of Froth, and a clear *Mucus* of a much thicker Consistence than the *Liquor Gastricus* naturally is; they had no Smell at all, the inside of the Stomach was not at all inflamed.

On opening the *Thorax* I found the Lungs a little redder than natural, with some Vessels on the outward Membrane of them very turgid: On cutting them out a pretty deal of clear red Blood ran from them. The Veins and both Ventricles of the Heart were turgid and full of coagulated Blood, of a dark brown Colour, which tinged my Fingers of a dirty yellow, as if some Gall had been mixed with it. There was no Blood in the Arteries; the *Foramen Ovale* was open.

On opening the Head, the *Dura Mater* appeared livid, as if bruised, it's Vessels and the *Sinus falci-formis* were turgid and full of the same Blood, as the Heart and Vessels near it. The cortical Substance of the Brain looked of an unusual livid Colour.

Next Day about Five in the Afternoon I took a large Mastiff Dog weighing seventy-five Pounds. We tied him to a Post as he stood on his Legs, one holding him strongly by the Tail, he being very fierce and unmanageable: We injected *per Anum* three Ounces of the second Running; in five Minutes he trembled and staggered much, would let us handle him, he drew his hind Legs after him, tumbled on his Head, panted and flabbered, but gradually recovered so as to stand up, though reeling and often sinking with his hind Legs. Fifteen Minutes after, we injected one Ounce more; he immediately staggered and sunk behind, soon after he made Water plentifully. We then led him to another Kennel, where he soon discharged the *Fæces alvinæ* plentifully, but of a hard Consistence:  
The



The *Fæces* seemed moistened with the last injected Ounce, which I imagined came away by this Stool ; I therefore immediately injected another Ounce, upon which he seemed more uneasy than before, tumbling on one Side, and in about ten Minutes after, he fell fast asleep, breathing with Difficulty ; half an Hour after, I roused him, found him snabbering, drowzy, sinking behind, and giddy. : About an Hour and a Quarter after the first Injection, I found him as before, but provoking him with a Stick, he bit at it, and tho' naturally fierce, he was very quiet when I did not strike him ; in a few Minutes he reeled and fell a snoring again : About Nine at Night he seemed very well, only drowzy. We left him all that Night without Water and Victuals, but thro' Hunger he eat some of the Straw he lay on, as we found afterwards upon opening his Stomach. Next Morning, we gave him Water and Bones ; he drank greedily, and eat the Bones, Bread, and whatever was given him, seeming perfectly recovered and well all Day and the next Night, only very thirsty, and a little drowzy, but perfectly gentle.

About Nine o'Clock the next Morning, we fastened him to a Post, and put a Rope into his Mouth, by which his Nose was tied fast to a Rail, great Care being taken that there should be no Rope about his Neck so tight, as to hinder his swallowing or his breathing : I then gave him three Ounces of the second Running, at three times, with a Horn, such as they drench Horses with ; he swallowed it with great Difficulty, and guggled some up again : To prevent which, I thrust the Horn a good way down his Throat. We then untied him from the Post, to see how he could walk, but he instantly reeled, fell down, rolled over and over, discharged much Urine, and some hard *Fæces alvinæ*, had no motion to vomit, but dribbled much, panted, and shewed great Difficulty of breathing, snuffing up the Air with his Nostrils, holding his Nose up, as he sat on his Breech ; for he could not then stand on his hind Legs : He often shook his Head, as if stung by some Fly : He gradually recovered, and in about twenty Minutes time could walk about very steadily on all his Legs, tho' he still appeared weakest behind : Wherefore imagining he might linger a long time, or perhaps recover entirely, we made him fast again, and gave him three Ounces more, near half of which he spilt ; and indeed out of the six Ounces, I don't believe above three or four entered his Stomach : He gave one terrible loud Howl, and sunk down at once, before we could untie him from the Post, to see whether he could walk or not. He never offered to rise again, but lay on one Side, panted, hung his Tongue out, and snabbered much, stretched all four Legs out three or four times, and was quite dead and motionless in about five Minutes time. I did not observe any Convulsion in the Muscles of the Neck and Back, nor was his Head and Tail drawn nearer together, as in the Puppy.

About



About half an Hour after I opened him, being still warm. I found the Bladder contracted and empty; the *Rectum* slightly inflamed, the small Guts not distended with Wind, but contracted, and almost close; the Bile was evacuated in a great Quantity into the *Duodenum*, and was very thick, appearing like congealed Honey; the Gall-bladder was almost empty; but what remained in it was as thick as the other; to the Inside of the Gall-bladder there adhered several Excrescencies in Form and Size of Lentils, like Drops of softish yellow Wax: The Liver was exceedingly inflamed, and almost livid: The Stomach was contracted near the *Pylorus*, and again about three Inches above it; we found some pieces of Bone in it, a pretty deal of Straw, and about two Ounces of Fluid, which smelt strong of the Laurel Water; but no *Mucus*, as in the Puppy: Some of the *Villi* seemed slightly inflamed, the Blood Vessels being very turgid: There was a great deal of *Mucus* in the *Oesophagus*, which did not seem inflamed. The Lungs appeared exceedingly contracted, and very red and inflamed. The *Vena cava* and all the Veins were vastly distended, and the Blood in them coagulated, tho' the Body was yet hot. There was little or no Blood in the *Aorta*; only on pressing it, a small Quantity of a transparent Fluid, which I took for *Serum*, flowed out of it. The Blood was strongly coagulated in the right Auricle and Ventricle of the Heart, being of a very dark Colour, and filled them quite; but the left Auricle and Ventricle contained only a small Clot of congealed Blood, which looked more red and florid: I kept some Clots of the Blood out of the Vein, and also out of the left Ventricle, twenty-four Hours, but neither of them liquified or run into *Serum*. I had the Head cut off, but Business preventing, I did not open it till twenty-four Hours after; a great deal of Blood drained from it, and upon opening it, the Vessels did not then appear distended, but the *Dura Mater* looked livid: There was no Blood at all in the *Sinus faliformis*; the Brain looked very well; the Vessels of the *Plexus Chorooides* in each Ventricle were not distended, but livid, nor were they burst, there being no Extravasation in the Ventricles, only a very small Quantity of Lymph; which was the Case likewise of the *Pericardium*, which had not above a Tea Spoonful of Water in it.

In both these Instances this Poison seems to act by coagulating the Blood; so that it can't pass the Lungs or Brain: And I take it that the Puppy lived longer than the great Dog; because in the Puppy the *Foramen Ovale* was open, by which the thickened Blood could pass, and perform a few Circulations more than it could have done, had it had the Lungs to pass thro'; and that in the Puppy the Brain was the Part the most affected, as was evident from the Convulsions it had. Whereas the Dog was little convulsed, but seemed to die of a Difficulty of Breathing; and the greatest Accumulation was found at the right Ventricle of the Heart.



## *Of the Poisonous Quality of the Laurel Water.*

I got a middling siz'd Spaniel and poured some Laurel Water down his Throat: He struggled pretty much at first, and whined; but when about an Ounce and half of it was down, he ceased struggling; that he might not be too long a dying, as much more was given him; he spilt about one third of the whole Quantity: He was then laid down on the Ground, but never offered to get up, only stretching out his Legs, expired presently. Mr *Ranby*, opened him immediately; there was about two Ounces of the Laurel Water found in his Stomach, and some frothy *Mucus*; the Veins in general were very turgid, but the Blood was still fluid; and indeed we could discern no Alteration in any of the *Viscera*.

I gave four Ounces of Laurel Water to Dr *Porter*, who forced three Ounces down a pretty large Dog. The Creature instantly returned about two Ounces by Vomit, clear and unaltered; in a few Minutes he grew prodigiously convulsed, soon after became motionless, and to all appearance was dying. Within ten Minutes he vomited a second time, and threw up a small Quantity of a viscid green, and very frothy Matter: From which Moment he began to recover, and within half an Hour was perfectly well. He was kept in the Yard all Night, and the next Morning not the least Disorder being to be perceived in him, he was turned out of Doors.

About half an Hour after Six in the Evening I gave about half an Ounce of the *Laurel Water* to a middle-sized Spaniel weighing near sixteen Pound, which he swallowed with great Reluctance. He remained about a Minute and half on his Legs; he then began to reel, and in about three Minutes more fell into most violent Convulsions, and his Neck and Tail were strongly drawn toward each other; he neither vomited nor purged, but we expected he would expire every Minute, the Convulsions being so exceedingly strong, when some of the Company called for some Milk, in order to try whether it would prove an Antidote to so *desperate a Poison*. We poured a little Milk into his Throat, which at first he could not swallow, but guggled it up again as if almost strangled with it. After several Trials he began to swallow some, about a spoonful at a time, and seemed a little relieved, his Convulsions leaving him, only fetching his Breath very hard; but he lay still and snorted, as if in a profound Sleep; and the Milk frothed out of his Nose: On rousing him, he opened his Eyes, and swallowed the Milk better, which seemed to revive him much; so that the Company imagining he would entirely recover, went away. I staid some time longer, till at last he began to lap the Milk himself when held up to it: He vomited up a pretty deal of Milk, which relieved him more; and then he lapped again, but could not stand on his Legs. I left him in this Condition about seven o'Clock, thinking he would have recovered, and left Orders that he should have a Pan of Milk, and another of Water, about a Pint of each, set by him, and that he should be

I

kept



kept shut up all Night.. About eleven o'Clock he was seen walking about; but next Morning he was found dead, after having drank up all the Milk and Water, and having vomited and purged pretty much.

XXVII. Maple Sugar is made of the Juice of Upland Maple, or Maple Trees that grow upon the Highlands. You box the Tree, as we call it, *i. e.* make a hole with an Axe, or Chizzel, into the Side of the Tree, within a Foot of the Ground; the Box you make may hold about a Pint, and therefore it must shelve inwards, or towards the bottom of the Tree; you must also bark the Tree above the Box to steer or direct the Juice to the Box.

*The Method of making Sugar from the Juice of the Maple Tree in New England, by Paul Dudley, Esq; F. R. S. No. 364. p. 27.*

You must also Tap the Tree with a small Gimblet below your Box, so as to draw the Liquor off. When you have pierced or tapped your Tree, or Box, you put in a Reed, or Pipe, or a bit of Cedar scored with a Channel, and put a Bowl, Tray or small Cask at the Foot of the Tree, to receive your Liquor, and so tend the Vessels as they are full.

After you have got your Liquor, you boil it in a Pot, Kettle, or Copper. Ten Gallons will make somewhat better than a pound of Sugar.

It becomes Sugar by the thin part evaporating in the boiling, for you must boil it till it is as thick as Treacle. Ten Gallons must boil till it comes to a Pint and half.

A Kettle of twenty Gallons will be near 16 Hours in boiling, before you can reduce in to three Pints; a good Fire may do it sooner.

When you take it off, you must keep almost continually stirring it, in order to make it Sugar: otherwise it will candy as hard as a Rock.

Some put in a little Beef Suet, as big as a Walnut, when they take it off the Fire, to make it turn the better to Sugar, and to prevent it's candying, but it will do without. A good large Tree will yield twenty Gallons. The Season of the Year is from the beginning of *February* to the beginning of *April*.

*Mr Dudley in a following Letter adds this Note.*

I have nothing to add to my Chapter of Maple Sugar, but that our Physicians look upon it not only to be as good for common use as the *West India* Sugar, but to exceed all other for it's Medicinal Virtue.

XXVIII. The Apple, that produces the *Molosses*, is a Summer-Sweeting, of a middling Size, pleasant to the Taste, and full of Juice, so that seven Bushels will make a Barrel of Cyder. The manner of making it is thus; you grind and press the Apples, and then take the Juice and boil it in a Copper till three Quarters of it is wasted, which will be done in about six Hours gentle boiling; and by that Time it comes to be of the Sweetness and Consistency of *Molosses*.

*A new Sort of Molosses made of Apples; by the same. No. 374. p. 231.*



Some of our People scum the Cyder as it boils, others do not, and yet there seems to be no great difference in the Goodness.

This new *Molosses* answers all the Ends of that made of the sweet Cane imported from beyond Sea. It serves not only for Food and brewing, but is of great Use also in preserving of Cyder; two Quarts of it put into a Barrel of rack'd Cyder, will both preserve and give it a very agreeable Colour.

The Apple *Molosses* was discovered a few Years since, by a Gentleman \* of my Acquaintance, at *Woodstock*, in this Province, a Town remote from the Sea, and where the *West-India Molosses* is dear and scarce; he ingenuously confesses the Discovery was purely accidental; but ever since he has supplied his Family with *Molosses* out of his Orchard, and his Neighbours also now do the like to their great Advantage.

Our Country Farmers run much upon planting Orchards of these Sweetings, for fattening their Swine, and assure me it makes the best sort of Pork. And I know the Cyder made of them to be better than that of other Fruit for Taste, Colour, and keeping.

XXIX. A Friend of mine having caused some Ashen Pipes (that brought Water to his Fountain during at least twelve Years) to be taken out of the Earth, they were left in a Yard not paved, where they rotted almost entirely: But in their room there did shoot forth from the Earth, a little Forest of Ash-trees. They are now in a flourishing Way, and about 3 or 4 Foot high. It is remarkable, that more than fifty young Trees are sprung up exactly where the Pipes had been laid, and no where else in the Yard. There is no Ash-tree there about, nor perhaps at a very great Distance, the Yard being in the Town.

XXX. Any body, that is acquainted with my Writings concerning the Natural History of *Swisserland*, will be sensible that we still want a *Botanography*, or Description of the Plants, which is one of its principal Parts; nay, that to which I chiefly have applied myself, and I dare add, without Offence to the censorious, which the World has long been in Expectation of: some Observations dispersed in my *Itinera Alpina*, published at *London* and *Leyden*, have raised a Desire for it among Botanists. It will thence appear to every one who applies himself to a Study as difficult as it is delightful, that I spared neither Labour nor Expences in searching after Plants of all Kinds that grow spontaneously in *Swisserland*, and describing them in the Places where they grow, in gathering them into Herbals, in comparing them with the Descriptions and Characters given of them by *Gesner*, the *Baubin's*, *Ray*, *Tournefort*, *Boccone*, and others, in separating what ought to be separated, in joining what ought to be joined, in resolving what is dubious, in retrenching what is superfluous, in

*Young Ash-trees springing from rotten Wood*, by Mr G. Cramer Prof. Math. Genev. N<sup>o</sup>. 413. p. 282.

*A Botanical Invitation to forward an History of the Plants of Swisserland*; by John Jacob Scheuchzer, M. D. F. R. S. Translated by Mr Zollman, F. R. S. N<sup>o</sup>. 421. p. 219.

\* J. Chandler, Esq;



supplying what is defective, in shewing the Use of native Plants, and trying them myself in my Practice. Of these my *History of Swiss Plants* which I am now hard at Work upon, is to consist; Of which, and it's Method, I intend now to give a brief Account, and draw up a Sort of Plan of it, in order to engage other Persons by this Invitatory Paper, as I may call it, to join with me in this Labour.

This Work will be in the Form of a Dictionary, to the End it may serve at the same time for an *Index*. I therefore am disposing in an Alphabetical Order, the Various Kinds and Characters, subjoining to each of them the proper Species hitherto observed in *Switzerland*, either by myself or by others, together with the synonymous Names used by the different Authors, which are again to be inserted in their proper Places, according to the Order of the Alphabet. I am adding, and remarking under each Plant, whatever seems to be wanting in their Description by other Authors, or is any ways necessary for the fuller Knowledge of them, or is applicable to Medicinal or other Uses. Besides other Prints, there will appear in the Work itself those of *Fuchsius* in Folio, I having purchased the Original Plates. I would add all the *Alpine* Plants, had I some Patrons at Hand who would bear the Expence of engraving the Copper Plates, or doing the wooden Cuts; an Assistance which may be best expected from the *English* Nation, and their *Society*.

XXXI. The Company of *Apothecaries* of *London*, having, in the Year 1673, established a *Physic-Garden*, which they have since furnished with a great Variety of Plants, for the Improvement of their Members in the Knowledge of Botany; Sir *Hans Sloane*, Bart. in order to encourage and promote an Undertaking so serviceable to the Public, has generously granted to the Company the Inheritance of the said Garden, being part of his Estate and Manor of *Chelsey*, on condition that it be for ever kept up and maintained by the Company as a *Physic-Garden*; and as an Evidence of it's being so maintained, he has directed and obliged the Company, in Consideration of the said Grant, to present Yearly, for ever, to the *Royal Society*, at one of their weekly Meetings, fifty Specimens of Plants, that have grown in the said Garden the preceding Year, which are all to be specifically distinct from each other, until the Number of 2000 Plants be completed. Which Specimens, together with those that are to follow them in subsequent Years, will, by order of the *Royal Society*, be carefully preserved for the Satisfaction of such curious Persons, as may desire to have recourse to them.



The Catalogue by Mr ISAAC RAND. F.R.S.

- No. 399. p. 293. Ann. 1726. 201. Abutilon Dod. 656.  
 1731. 452. Abutilon Americanum, foliis variis, flore eleganti  
 cæruleo calyce insidente.  
 1731. 453. Abutilon Americanum folio longius cuspidato, fructu  
 quinquecapsulari.
- No. 399. p. 293. 1726. 202. Abutilon Americanum, fructu subrotundo pendulo,  
 è capsulis vesicariis crispis conflato.  
 1731. 451. Abutilon Americanum, viscosum, graveolens, mini-  
 mo flore & fructu.
- No. 383. p. 93. 1723. 51. Abutilon Carolinianum, reptans, Alceæ foliis, gilvo  
 flore.
- No. 417. p. 1. 1729. 351. Acer Fraxini foliis, ferratis. *Acer maximum, foliis*  
*trifidis & quinquesidis, Virginianum.* Pluk. Phyt. Tab.  
 123. Fig 4 & 5.
- No. 407. p. 1. 1727. 251. Acetosa Ocimi folio, Neapolitana C. B. 114.  
 No. 407. p. 1. 1727. 252. Acetosa vesicaria peregrina Hort. Eyft.  
 No. 422. p. 223. 1730. 401. Adhatoda Zeylanensium. Hort Lugd. Bat. 642.  
 No. 422. p. 223. 1730. 403. Ageratum breviori & latiori folio. *Ptarmica lutea,*  
*suaveolens, corymbis longioribus & magis compactis.* T.  
 Inst. 497.
- No. 422. p. 223. 1730. 402. Ageratum foliis ferratis. C. B. 221. *Ageratum plerif-*  
*que; Herba Julia quibusdam* J. B. 111. pag. 142.
- No. 422. p. 223. 1730. 404. Ageratum Hispanicum; amplioribus foliis; flosculis  
 minoribus.
- No. 417. p. 1. 1729. 354. Agrimonia minor; flore albo. H. C. Boer. Ind.  
 No. 417. p. 1. 1729. 352. Agrimonia odorata. Cam. Hort.  
 No. 417. p. 1. 1729. 353. Agrimonia officinarum. T. Inst. 301.  
 1731. 454. Alaternoides Africana, Ericæ foliis, floribus albi-  
 cantibus & muscosis. H. Amst. 11. pag. 1.
- No. 407. p. 1. 1727. 253. Alcea Afra, frutescens, folio Grossulariæ; flore  
 parvo rubro Boer. Ind. alt. 271.
- No. 407. p. 1. 1727. 254. Alcea Afra, frutescens, Grossulariæ folio ampliore;  
 unguibus florum atro-rubentibus.
- No. 395. p. 125. 1725. 152. Alchimilla Alpina, pubescens, minor, H. Reg. Par.  
 No. 407. p. 1. 1727. 255. Alchimilla montana minima Col. Ecphr. 146.  
 No. 395. p. 125. 1725. 151. Alchimilla vulgaris C. B. 319.  
 No. 399. p. 393. 1726. 203. Alkekengi Barbadense, patulum, parvo flore; fructu  
 amplo mucrone productiori.
- No. 399. p. 293. 1726. 205. Alkekengi Curaçavicum, foliis Origani incanis, flore  
 vietè Sulphureo, fundo purpureo Boerh. Ind. alt. 11.  
 p. 66.
- No. 399. p. 293. 1726. 204. Alkekengi Indicum majus, T. Inst. 151.



206. Alkekengi Verticillato simile; foliis angustioribus, No. 399. p. 293. Ann. 1726.  
utrinque a cuminatis.
207. Alkekengi Virginianum perenne majus; flore luteo No. 399. p. 293. 1726.  
amplo fructu minimo.
258. Althæa arborea, folio amplo ferrato. No. 407. p. 1. 1727.
259. Althæa Dioscoridis & Plinii C. B. 315. No. 407. p. 1. 1727.
260. Althæa Dioscoridis & Plinii, folio magis angulato. No. 407. p. 1. 1727.  
T. Inst. 97.
257. Althæa frutescens Bryoniæ folio. C. B. 316. No. 407. p. 1. 1727.
256. Althæa frutescens, folio acuto, parvo flore, C. B. No. 407. p. 1. 1727.  
316.
53. Alysson Veronicæ folio T. Inst. 217. *Bursa Pastoris* No. 383. p. 93. 1723.  
*major loculo oblongo.* C. B. Prod.
455. Amaranthoides humile, Polygoni folio, Sloan, Hist. 1731.  
Jam. Tab. 36. f. 2.
261. Ambrosia gigantea, inodora; foliis asperis trifidis No. 407. p. 1. 1727.  
Banist. Cat. Raii. Hist. Ap. 1928.
52. Ambrosia maritima, Artemisiæ foliis inodoris, elatior No. 383. p. 93. 1723.  
H. Lugd. Bat.
456. Ammi majus foliis plurimum incis, & nonnihil cris- 1731.  
pis C. B. 159.
208. Ammi perenne Moris, Umb. 22. No. 399. p. 293. 1726.
355. Anapodophyllon Canadense Morini. T. Inst. 239. No. 417. p. 1. 1729.
1. Anemone Virginiana, tertiæ Matthioli similis, flore No. 376. p. 280. 1722.  
parvo. Par. Bat. 18.
457. Anemonospermos Afra; folio Jacobææ, tenuiter 1731.  
laciato flore aurantio pulcherrimo Boer. Ind. alt.  
100.
458. Anemonospermos Africana, folio Cardui Benedicti 1731.  
florum radiis intus albicantibus Hort. Amst. II. 45.
459. Anemonospermos Africana, folio minus laciniato, 1731.  
flore intus aureo, foris punicante.
301. Anonis Americana; folio latiori, subrotundo. T. Inst. No. 412. p. 219. 1728.  
409.
405. Anonis pulchra visu; folio Ciceris; Ornithopodii No. 422. p. 223. 1730.  
filiquis, annuentibus; Hort. Cath. 18.
408. Aparine minima, D. Sherard. Raii. Syn. Ed. 2. 118. No. 422. p. 223. 1730.
406. Aparine femine Coriandri faccharati. Park. Theat. No. 422. p. 223. 1730.  
567.
407. Aparine femine læviore, Raii Hist. 484. No. 422. p. 223. 1730.
356. Apocynoides subhirsuta; floribus aurantiis. No. 417. p. 1. 1729.
460. Apocynum Americanum foliis Androsæmi majoris, 1731.  
flore Lili Convallium, suave rubentis H. R. Par.
461. Apocynum erectum folio oblongo, flore umbellato, 1731.  
petalis coccineis reflexis Sloane Hist. 1. 206. Tab.  
129. fig 4 & 5.



- No. 412. p. 219. Ann. 1728. 302. *Apocynum frutescens*; *Salicis folio, angusto. An Apocynum erectum, Africanum; villoso fructu; Salicis folio, glabro, angusto. Par. Bat. 24?*
- No. 399. p. 293. 1731. 462. *Apocynum minus, rectum Canadense Cornut. 93.*
- No. 417. p. 1. 1726. 209. *Apocynum scandens, Africanum, Convolvuli minoris folio & caule hirsutis, Pluk. Phyt. Tab. 137. fig. 4.*
- No. 422. p. 223. 1728. 357. *Aracus q. Vicia segetum; singularibus filiquis glabris C.B. 345.*
- No. 407. p. 1. 1730. 409. *Arundo arborea Indica; amplo pediculato folio. Bambu altera Species Raii Hist. 1316. Beesha. Hort Malab. Tom. 5. Tab. 60.*
- No. 395. p. 125. 1727. 262. *Asperugo vulgaris T. Inst. 135.*
- No. 395. p. 125. 1725. 153. *Aster Americanus Belviderae foliis, floribus ex caeruleo albicantibus, spicis praelongis. Pluk. Phyt. Tab. 78. fig. 5.*
- No. 412. p. 219. 1728. 303. *Aster Americanus, serotinus, altissimus; folio brevi, caulem amplexante.*
- No. 395. p. 125. 1725. 156. *Aster maritimus flavus, Crithmum chrysanthemum dictus. Raii. Hist. 268.*
- No. 383. p. 93. 1723. 55. *Aster montanus Salicis glabro folio. C. B. 266.*
- No. 383. p. 93. 1723. 54. *Aster peregrinus, Cisti folio non crenato flore magno, luteo. Pluk. Phyt. T. 16. f. 2.*
- No. 395. p. 125. 1725. 154. *Aster Virginianus, angustifolius, serotinus, parvo albente flore, Park. Th. 132.*
- No. 395. p. 125. 1725. 155. *Aster Virginianus, pyramidatus, Hyssopi foliis, asperis, calycis squamulis foliaceis.*
- No. 407. p. 1. 1727. 263. *Barba Jovis, Caroliniana, arborescens; Pseudoacaciae foliis, Bastard Indigo, incolis.*
- No. 376. p. 280. 1722. 2. *Bellis Africana, capitulo aphylo luteo, Coronopi folio, caulibus procumbentibus. H. Lugd. Bat.*
- No. 412. p. 219. 1728. 304. *Betonica maxima; Scrophulariae folio; flore è luteo pallescente. Schol. Bot. 64.*
- No. 412. p. 219. 1728. 305. *Betonica maxima; Scrophulariae folio; floribus incarnatis. Par. Bat 106.*
- No. 399. p. 293. 1726. 210. *Bidens Americana Apii folii. T. 462.*
- No. 399. p. 293. 1726. 211. *Bidens Americana nodiflora foliis latis acuminatis. Chrysanthemum Conyzoides, nodiflorum; semine rostrato bidente, Sloan. Hist. Vol. 1. p. 62. Tab. 154. f. 4.*
- No. 399. p. 294. 1726. 212. *Bidens Caroliniana; florum radiis latissimis, insigniter dentatis; semine alato, per maturitatem convoluto.*
- No. 383. p. 93. 1723. 56. *Bidens Indica, Hieracii folio, caule alato. T. Inst. 462.*
- No. 383. p. 93. 1723. 57. *Blitum monospermum, indicum, aculeatum. Breyn. Prod. 18.*



58. *Blitum* quod *Amaranthus* Græcus, sylvestris, angustifolius. T. Cor. 17. No. 383. p. 93. Ann. 1723.
358. *Brassica* orientalis, perfoliata; flore albo; siliqua quadrangula T. Cor. 16. No. 417. p. 1. 1729.
157. *Brunella* Caroliniana, magno flore, dilute cœruleo; internodiis prælongis. No. 395. p. 125. 1725.
359. *Brunella* laciniata; flore elegantissime sulphureo. Boer. Ind. alt. 169. No. 417. p. 1. 1729.
158. *Brunella* Novæ Angliæ, major; foliis longius mucronatis. No. 395. p. 125. 1725.
213. *Buglossum* Lusitanicum, bullatis foliis Moris. Hort. Bles. 1. No. 399. p. 294. 1726.
3. *Bupleurum* angustifolium. Dod. 633. No. 376. p. 280. 1722.
4. *Calamintha*, magno flore, C. B. 229. No. 376. p. 280. 1722.
59. *Calcitrapoides* pumila, supina, tenuifolia, calyce turbinato. D. Vaillant. Act. Ac. Par. No. 383. p. 93. 1723.
214. *Caltha* Africana, flore intus albo foris violaceo T. Inst. 499. No. 399. p. 294. 1726.
410. *Canna* Indica; radice alba, alexipharmica, Sloan. Cat. Jam. 122. Hist. Tab. 149. fig. 2. *Arrow-root*. No. 422. p. 224. 1730.
216. *Cardamine* impatiens altera hirsutior. Raii Synopf. No. 399. p. 294. 1726.
215. *Cardamine* impatiens, vulgo *Sium* minus impatiens, Gerard. No. 399. p. 294. 1726.
5. *Carduus* capite rotundo tomentoso. C. B. 382. No. 376. p. 280. 1722.
264. *Carlina* patula, *Atractylidis* folio & facie T. Inst. 500. No. 407. p. 1. 1727.
412. *Caryophyllata*, aquatica, nutante flore C. B. 321. No. 422. p. 224. 1730.
413. *Caryophyllata* major; nutante flore. No. 422. p. 224. 1730.
414. *Caryophyllata* Virginiana; albo flore, minore; radice inodora. H. Lugd. Bat. 121. No. 422. p. 224. 1730.
411. *Caryophyllata* vulgaris. C. B. 321. No. 422. p. 224. 1730.
60. *Cassia* decaphylla, *Orobi* Pannonici foliis mucronatis. No. 383. p. 93. 1723.
360. *Cassida* Cretica; fruticosa; *Catarix* folio; flore albo. T. Cor. 11. No. 417. p. 1. 1729.
362. *Cassida* orientalis; *Chamædryos* folio; flore luteo. T. Cor. 11. No. 417. p. 2. 1729.
361. *Cassida* palustris, vulgatior; flore cœruleo. T. Inst. 182. No. 417. p. 1. 1729.
62. *Cataria* angustifolia minor. T. Inst. 202. No. 383. p. 93. 1723.
64. *Cataria* Hispanica, *Betonix* folio angustiori, flore albo. T. Inst. 202. No. 383. p. 94. 1723.
65. *Cataria* Lusitanica, erecta, *Betonix* folio, tuberosa radice. T. Inst. No. 383. p. 94. 1723.
61. *Cataria* major vulgaris. T. Inst. 202. No. 383. p. 93. 1723.
67. *Cataria* orientalis, *Teucrij* folio, *Lavendulæ* odore, verticillis florum crassissimis. T. Cor. 13. No. 383. p. 94. 1723.



- No. 383. p. 94. Ann. 1723. 66. *Cataria quæ Horminum spicatum, Lavendulæ flore & odore.* Boccon. rar. 48.
- No. 383. p. 93. 1723. 63. *Cataria quæ Nepeta Pannonica major & elatior.* H. Ox. 3. 415.
- No. 395. p. 125. 1725. 159. *Caucalis Hispanica,* Cam. Hort. 37. fig. XI.
- No. 422. p. 224. 1730. 415. *Caucalis Monspeliaca; echinato magno fructu.* C. B. 153.
- No. 407. p. 1. 1727. 265. *Centaurium foliis Cynaræ Cornut.* 72.
- No. 422. p. 224. 1730. 416. *Chamædrys Alpina, frutescens; folio splendente.* T. Inst. 205.
- No. 412. p. 219. 1728. 307. *Chamædrys; foliis parvis leviter crenatis.*
- No. 412. p. 219. 1728. 308. *Chamædrys; frutescens; Teucrium vulgo.* T. Inst. 205.
- No. 412. p. 219. 1728. 209. *Chamædrys; laciniatis foliis.* Lob. Icon. 385.
- No. 412. p. 219. 1728. 210. *Chamædrys, quæ Teucrium Hispanicum, supinum; Verbenæ tenuifoliæ foliis.* D. Goiffon. D. Jussieu.
- No. 412. p. 219. 1728. 306. *Chamædrys, vulgo vera existimata.* J. B. 3. 288.
- No. 422. p. 224. 1730. 419. *Chamæmelum Hispanicum, humile, ramosissimum; Cotulæ foetidæ facie.*
- No. 422. p. 224. 1730. 418. *Chamæmelum incanum; Absinthii vulgaris folio,* D. Vaillant. Ac. Reg. Sc. 1720.
- No. 422. p. 224. 1730. 417. *Chamæmelum montanum; Absinthii folio; Parthenii odore.* Hort. Cath.
- No. 422. p. 224. 1730. 420. *Chelone Acadiensis; flore albo.* D. Tournef. Ac. Reg. Sc. 1706. Josselyn *New England's Rarities*, Num. 6. p. 78, & 79.
- No. 383. p. 94. 1723. 69. *Chrysanthemum flore luteo, aphylo minore.* Bar. Icon. 452.
- No. 376. p. 280. 1722. 6. *Chrysanthemum perenne, minus, Salicis folio glabro* H. Ox. p. 3. 21.
- No. 383. p. 94. 1723. 68. *Chrysanthemum tenuifolium, flore bullato aureo* Bar. Ic. 450.
- No. 407. p. 1. 1727. 266. *Circæa Lutetiana* Lob. icon. 266.
- No. 407. p. 1. 1727. 267. *Circæa minima.* Col. Ecphr. 80.
- No. 376. p. 280. 1722. 7. *Cirsium altissimum, albis maculis notatum, semine viscoso.* *Carduus albis maculis notatus, capitulis Cirsii.* Schol. Bot. 215.
- No. 383. p. 94. 1723. 70. *Cirsium humile, ramosum, foliis integris.*
- No. 376. p. 280. 1722. 8. *Clematitis cœrulea erecta.* C. B. 300.
- No. 399. p. 294. 1726. 217. *Clematitis peregrina foliis pyri incisfis* C. B. 300.
- No. 376. p. 280. 1726. 9. *Clematitis five Flammula surrecta alba.* J. B. 2. 127.
- No. 376. p. 281. 1722. 10. *Cnicus perennis cœruleus, Tingitanus.* H. Lugd. Bat. 162.
1731. 463. *Colutea Orientalis, flore sanguinei coloris, lutea macula notato* T. Cor. 44.



219. *Coma aurea Africana fruticans, foliis Crithmi marini* No. 399. p. 294. Ann. 1726.  
H. Amst. 2. 99.
464. *Coma aurea Germanica Park.* Theat 688. 1731.
311. *Commelina graminea, latifolia; flore cœruleo.* Plum. No. 412. p. 219. 1728.  
N. Gen. Plant.
363. *Convolvulus Canariensis; longioribus foliis, mollibus* No. 417. p. 2. 1729.  
& incanis. Pluk. Phyt. Tab. 325. fig. 1.
268. *Conyza Africana, frutescens; foliis Salviæ; odore* No. 407. p. 1. 1727.  
*Camphoræ.* T. Inst. 455.
11. *Conyza Africana, Senecionis flore, retusis foliis* H. No. 376. p. 281. 1722.  
Lugd. Bat.
312. *Conyza Orientalis, humilis; Verbasci folio, candi-* No. 412. p. 220. 1728.  
*diffimo. An Conyza tomentosa & candidissima; subro-*  
*tundo, crasso folio; flore luteo* D. Sherard. Ac. Reg. Sc.  
Par. An. 1719.
218. *Corchorus five Melochia* J. B. 2. 982. No. 399. p. 294. 1726.
160. *Corchorus, Americana, prælongis foliis, capsula* No. 395. p. 125. 1725.  
*striata, subrotunda, brevi,* Pluk. Phyt. Tab. 255.  
fig. 4.
12. *Corona Solis altissima, alato caule.* T. Inst. 490. No. 376. p. 281. 1722.
161. *Corona Solis Caroliniana, parvis floribus, folio tri-* No. 395. p. 125. 1725.  
*nervi amplo, aspero, pediculo alato.*
162. *Corona Solis Rapunculi radice,* T. Inst. 490. No. 395. p. 125. 1725.
313. *Corona Solis; Trachelii folio; radice repente.* T. Inst. No. 412. p. 220. 1728.  
490.
314. *Corona Solis; Trachelii folio, ramosior; radice non* No. 412. p. 220. 1728.  
*repente.*
315. *Corona Solis; Trachelii folio, tenuiore; calyce* No. 412. p. 220. 1728.  
*floris foliato.*
13. *Coronilla maritima glauco folio.* T. Inst. 650. No. 376 p. 281. 1722.
316. *Cotinus coriaria.* Dod. 780. No. 412. p. 220. 1728.
465. *Crambe maritima Brassicæ folio* Tourn. 211. 1731.
14. *Cucubalus Plinij.* Lugd. 1429. No. 376. p. 281. 1722.
467. *Cyanus angustiore folio & longiore Belgicus* H. R. 1731.  
Par.
466. *Cyanus montanus latifolius vel Verbasculum Cya-* 1731.  
*noides* C. B. 273.
15. *Daucus Fœniculi foliis tenuissimis* C. B. 150. No. 376. p. 281. 1722.
16. *Daucus maritimus lucidus.* T. Inst. 307. No. 376. p. 281. 1722.
364. *Daucus, qui Pastinaca Œnanthes folio* Boccon. rar. 75. No. 417. p. 2. 1729.
17. *Dens Leonis, foliis Erysimi vulgaris.* T. Cor. 35. No. 376. p. 281. 1722.
163. *Dictamnus Creticus,* C. B. 222. No. 395. p. 125. 1725.
318. *Doria; foliis tenuiter ferratis, ad caulem latis.* An No. 412. p. 220. 1728.  
*Alisma Monspeliensium; five Doria.* J. B. 2. 1064.
317. *Doria major, repens. Virga aurea maxima; radice re-* No. 412. p. 220. 1728.  
*pente; five Dorea major; repens.* D. Bobart. H. Ox. 3. 123.



- No. 412. p. 220. Ann. 1728. 319. Doria; quæ *Jacobæa Orientalis*, *Limonii folio*. T. Cor. 36.  
 No. 395. p. 125. 1725. 164. *Dorycnium Monspeliensium*, Lob. icon. 2. 51.  
 No. 417. p. 2. 1729. 365. *Echinopus minor*, annuus; magno capite. T. Inst. 463.  
 No. 412. p. 220. 1728. 320. *Elatine*, folio acuminato in basi auriculato; flore luteo. C. B. 253.  
 No. 412. p. 220. 1728. 321. *Elatine*; folio subrotundo. C. B. 253.  
 No. 412. p. 220. 1728. 322. *Elatine Hispanica*, rotundifolia; pediculis florum brevissimis.  
 1731. 468. *Elichrysum Africanum* folio oblongo subtus cano, supra viridi, flore luteo Boer. Ind. 42.  
 1731. 469. *Elichrysum Africanum* folio oblongo, angusto, flore rubello, postea aureo Boer. Ind. 42.  
 1731. 470. *Elichrysum Americanum* annum folio oblongo ex angusto in orbem desinente.  
 No. 407. p. 2. 1727. 269. *Elichrysum montanum*, longiore & folio & flore purpureo T. Inst. 453.  
 No. 395. p. 126. 1725. 165. *Elichrysum sylvestre*, latifolium, capitulis conglobatis. C. B. 264.  
 No. 422. p. 224. 1730. 422. *Eupatoriophalacron Americanum*, procumbens; albis floribus; foliis parvis undulatis, asperis.  
 No. 422. p. 224. 1730. 423. *Eupatoriophalacron Americanum*, *Scrophulariæ acutioris* folio; disco luteo, prominente, stipato, vix radiato.  
 No. 422. p. 224. 1730. 421. *Eupatoriophalacron*, *Balsaminæ fœminæ* folio; flore albo discoide. D. Vaillant. Ac. Reg. Sc. 1720. *Scabiosa Conyzoides*, *Americana*; capitulis & floribus albidis parvis. P. B. P. Pluk. Phyt. Tab. 109. f. 1.  
 No. 422. p. 225. 1730. 424. *Eupatoriophalacron Indicum*; *Scrophulariæ* folio; capitulo parvo, radiis quinque ad basin ornato, hispidis & glutinosis. An *Cichoreo affinis Lampfana Sinica*, *Mentastri foliis*; calyce fimbriato, hispido. Sinice *Hi-bim-tsaw dicta*? Pluk. Amalt. 58. Phyt. Tab. 380. Fig. 2.  
 No. 395. p. 126. 1725. 166. *Eupatorium Senecionis facie*, folio *Lamii*. Par. Bat. Ic. 161.  
 No. 407. p. 2. 1727. 270. *Eupatorium Valerianoides*, *Triffaginis* folio, absque pediculis, *Virginianum*. Pluk. Phyt. Tab. 83. f. 4.  
 No. 412. p. 220. 1728. 323. *Ferrum equinum*, *Germanicum*; siliquis in summitate. C. B. 349.  
 No. 395. p. 126. 1725. 167. *Fœnum Græcum*, quod *Melilotus corniculis reflexis* major C. B. 331.  
 No. 422. p. 225. 1730. 425. *Fœnum Græcum sativum*. C. B. 348.  
 No. 422. p. 225. 1730. 426. *Fœnum Græcum sylvestre*; polyceration, majus, *Creticum* Breyn Cent. 79.  
 No. 422. p. 225. 1730. 427. *Fœnum Græcum sylvestre*, polyceration, minus, *Monspeliacum*. Breyn. Cent. 79. *Hedysarum minus*, *Dalechamp. Hist. Lugd.* 446.



366. Frutex Africanus, Ambram spirans Pluk. Phyt. No. 417. p. 2. Ann. 1729.  
Tab. 183. Fig. 1.
168. Fumaria minor, tenuifolia, cauliculis procumbentibus & caducis. C. B. 143. No. 395. p. 126. 1725.
471. Galeopsis foetidissima spica longissima alba Micheli. 1731.
367. Galeopsis Hispanica; frutescens; Teucris folio. T. No. 417. p. 2. 1729.  
Inst. 186.
169. Genista Hispanica humilis, floribus congestis villosis. No. 395. p. 126. 1725.  
Sparto primo affinis, C. B. 396.
133. Geranium acu longissimâ, Cicutæ folio tenuius laciniato. *Geranium Cicutæ folio, viscosum, acu longissima*  
*D. Jussieu.* No. 388. p. 306. 1724.
324. Geranium Ægyptiacum; Althææ folio, subtus glauco. No. 412. p. 220. 1728.  
Lippii D. Jussieu.
135. Geranium Æthiopicum, noctu olens, radice tuberosa, No. 388. p. 307. 1724.  
foliis Myrrhidis angustioribus Breyn. Cent.
142. Geranium Africanum Alchimillæ hirsuto folio, floribus albidis. H. Lugd. Bat. 282. No. 388. p. 307. 1724.
147. Geranium Africanum arborescens, Alchimillæ hirsuto folio, floribus rubicundis. Com. Præl. 51. No. 388. p. 307. 1724.
148. Geranium Africanum arborescens folio Malvæ plano lucido, glabro, flore Kermesino, Di van Leur. Boerh. No. 388. p. 307. 1724.  
Ind. 109.
150. Geranium Africanum arborescens Ibis folio anguloso; floribus amplis purpureis: *Geranium Africanum frutescens, Alchimillæ folio hirsuto, cum fimbriis purpureis.*  
*Boer. Ind. 110.* No. 388. p. 307. 1724.
149. Geranium Africanum arborescens Ibis folio rotundo; Carlinæ odore H. L. Bat. 274. No. 388. p. 307. 1724.
146. Geranium Africanum arborescens, Malvæ folio mucronato, petalis florum inferioribus vix conspicuis. No. 388. p. 307. 1724.
139. Geranium Africanum Betonicæ folio, procumbens, floribus parvis, eleganter variegatis. Pluk. Alm. 169. No. 388. p. 307. 1724.
136. Geranium Africanum Coriandri folio, floribus incarnatis, minus H. L. Bat. 279. No. 388. p. 307. 1725.
140. Geranium Africanum foliis inferioribus Afari, superioribus Staphidis agriæ, maculatis, splendentibus, & Acetosæ sapore. Com. Præl. 52. No. 388. p. 307. 1724.
143. Geranium Africanum folio Malvæ crasso, molli, odoratissimo, flosculo pentapetalo, albo. Boerh. Ind. alt. 263. No. 388. p. 307. 1724.
137. Geranium Africanum frutescens, Chelidonii folio, petalis florum angustis, albidis; carnosio caudice. No. 388. p. 307. 1724.
141. Geranium Africanum frutescens, folio crasso & glauco, Acetosæ Sapore Com. Præl. 54. No. 388. p. 307. 1724.



- No. 388. p. 307. Ann 1724. 145. *Geranium Africanum frutescens Malvæ folio laciniato instar Melissæ, flore purpurascente.* Boerh. Ind. 110.
- No. 388. p. 307. 1724. 144. *Geranium Africanum frutescens Malvæ folio laciniato odorato.* H. L. Bat. 277.
- No. 388. p. 307. 1724. 138. *Geranium Africanum Noctu olens, tuberosum & nodosum, Aquilegii foliis.* H. L. Bat. 284.
- No. 412. p. 220. 1728. 325. *Geranium Alpinum; Coriandri folio; longius radicum; flore purpureo.* D. Micheli Hort. Pisan. 68.
- No. 388. p. 306. 1724. 116. *Geranium Annuum minus Batrachoides, Bohemicum, purpureo violaceum.* H. Ox. p. 2. 511.
- No. 388. p. 306. 1724. 129. *Geranium Arvense, album.* Tabern. Icon. 57.
- No. 388. p. 306. 1724. 113. *Geranium Batrachoides, Gratia Dei Germanorum* C. B. 318.
- No. 388. p. 306. 1724. 114. *Geranium Batrachoides montanum nostras.* Raii Hist. 1062.
- No. 388. p. 306. 1724. 115. *Geranium Batrachoides odoratum.* C. B. 318.
- No. 388. p. 306. 1724. 125. *Geranium Chium vernal, Caryophyllatæ folio.* T. Cor. 20.
- No. 388. p. 306. 1724. 132. *Geranium Cicutæ folio, acu longissima.* C. B. 319.
- No. 395. p. 126. 1725. 170. *Geranium Cicutæ folio, erectum, Romanum.* Boc. Mus. p. 2. 93.
- No. 388. p. 306. 1724. 128. *Geranium Cicutæ folio minus & supinum* C. B. 319.
- No. 388. p. 306. 1724. 127. *Geranium Cicutæ folio moschatum.* C. B. 319.
- No. 376. p. 281. 1722. 18. *Geranium columbinum dissectis foliis, pediculis florum longissimis.* Raii Syn. 218.
- No. 395. p. 126. 1725. 171. *Geranium columbinum erectum, Carolinianum floribus purpurascens.*
- No. 388. p. 305. 1724. 105. *Geranium columbinum humile, flore cœruleo minimo* Raii Syn. Ed. 3. p. 359. *Geranium columbinum tenuius laciniatum.* C. B. 318. *Prod.* 138.
- No. 388. p. 305. 1724. 106. *Geranium Columbinum majus, flore minore, cœruleo* R. Hist. 1058.
- No. 388. p. 305. 1724. 107. *Geranium Columbinum maximum, dissectis foliis* Plot. Hist. Ox.
- No. 376. p. 281. 1722. 19. *Geranium Columbinum perenne Pyrenaicum maximum* T. Inst. 268.
- No. 388. p. 305. 1724. 104. *Geranium Columbinum petalis florum bifidis albis.* *An Ger. Malachoides, flore albo.* H. Reg. Bles. 1.
- No. 388. p. 305. 1724. 103. *Geranium Columbinum vulgare, petalis florum bifidis, purpureis.* *Geranium secundum Cam. Epit.* 600.
- No. 388. p. 306. 1724. 126. *Geranium folio Alceæ, tenuitur laciniato, flore pentapetalo, purpurascens, semine tenui* Boerh. Ind. alt. 266.
- No. 388. p. 306. 1724. 123. *Geranium folio Althææ.* C. B. 318.
- No. 388. p. 306. 1724. 124. *Geranium folio Althææ floribus saturatius rubentibus* H. L. Bat. 290.



305. *Geranium folio Malvæ rotundo. C. B. 318. Geranium majus foliis in breviores & latas lacinias divis.* No. 388. p. 305. Ann. 1724.
111. *Geranium Hæmatodes, foliis majoribus, pallidioribus & altius incis.* D. Dale. Raii Syn. 219. No. 388. p. 305. 1724.
112. *Geranium Hæmatodes Lancaſtrenſe, flore eleganter ſtriato.* Raii Hiſt. 1061. No. 388. p. 306. 1724.
131. *Geranium latifolium longiſſima acu.* C. B. 319. No. 388. p. 306. 1724.
101. *Geranium lucidum faxatile.* C. B. 318. No. 388. p. 305. 1724.
122. *Geranium lucidum faxatile foliis Geranii Robertiani.* D. Sherard. Raii Syn. 218. No. 388. p. 306. 1724.
118. *Geranium magnum, folio trifido.* J. B. T. 3. 478. No. 388. p. 306. 1724.
130. *Geranium Myrrhinum, tenuifolium, amplo flore purpureo.* Barrel. ob. 55. No. 388. p. 306. 1724.
108. *Geranium orientale Columbinum, flore maximo, Aphodeli radice.* T. Cor. 20. No. 388. p. 305. 1724.
117. *Geranium Phæum, flore reflexo.* J. B. T. 3. 477. No. 388. p. 306. 1724.
20. *Geranium puſillum maritimum ſupinum, Althææ aut Betonicæ folio noſtras.* Raii Syn. 216. No. 376. p. 281. 1722.
120. *Geranium Robertianum primum.* C. B. 319. No. 388. p. 306. 1724.
121. *Geranium Robertianum rubens, flore albo.* No. 388. p. 306. 1724.
119. *Geranium Romanum verſicolor, ſive ſtriatum.* Park. Parad. 229. No. 388. p. 306. 1724.
110. *Geranium ſanguineum cauliculis erectis, flore minore.* H. L. Bat. 286. No. 388. p. 305. 1724.
109. *Geranium ſanguineum maximo flore.* C. B. 318. No. 388. p. 305. 1724.
134. *Geranium triſte Cornuti* 109. No. 388. p. 307. 1724.
271. *Glychyrrhiza capite echinato.* C. B. 352. No. 407. p. 2. 1727.
21. *Gnaphalodes Luſitanica.* T. Inſt. 439. No. 376. p. 281. 1722.
272. *Gramen dactylon, majus; panicula longa; ſpicis plurimis nudis craſſis.* Sloane, Hiſt. Vol. I. 112. Tab. 69. f. 2. No. 407. p. 2. 1727.
273. *Gramen dactylon, panicula longa, è ſpicis plurimis gracilioribus, purpureis mollibus conſtante.* Sloan. Hiſt. Vol. I. 113. Tab. 70. f. 2. No. 417. p. 2. 1727.
368. *Hedypnois annua.* T. Inſt. 478. No. 417. p. 2. 1729.
369. *Hedypnois Cretica, minor, annua.* T. Cor. 36. No. 417. p. 2. 1729.
370. *Hedypnois Hiſpanica, procumbens; magno capite.* An *Hedypnois annua, capite maximo Boerb.* Ind. alt. 93. No. 417. p. 2. 1729.
472. *Hedyſarum triphyllum, frutiſoſum flore purpureo ſiliqua varie diſtorta.* Sloane Hiſt. 184. Tab. 116. f. 2. 1731.
371. *Heleniaſtrum; folio longiore & anguſtiore.* D. Vailant. Acad. Reg. Par. anno 1720. No. 417. p. 2. 1729.
372. *Heleniaſtrum ſerius florens; latiore folio; ramoſiſſimum.* An *Heleniaſtrum; folio brevior & latiore.* Ejusdem. ibid. ? No. 417. p. 2. 1729.
72. *Helianthemum ampliore folio, flore roſeo.* D. Sherard. No. 383. p. 94. 1723.



- No. 383. p. 94. Ann. 1723. 71. *Helianthemum Anglicum*, vulgari simile, flore stellato.
- No. 383. p. 94. 1723. 73. *Helianthemum Halimi folio*, angustiore, acuto. *An Cistus Halimi folio*, 2. *Clus. Hist.* 71?
- No. 407. p. 2. 1727. 274. *Heliotropium Americanum*, cœruleum; foliis Hormini. Dodart mem. 83.
- No. 407. p. 2. 1727. 275. *Heliotropium majus Dioscoridi*. C. B. 253.
1731. 473. *Heliotropium maritimum*, minus, folio glauco, flore albo Sloane Hist. 1. 213. Tab. 132. f. 3.
- No. 412. p. 221. 1728. 327. *Hermannia*; Alni folio parvo. *An Ketmia Africana, fruticans & erecta*; Alni foliis latioribus & majoribus; flore spirali sulphureo. Hort. Amst. p. 2. 155?
- No. 395. p. 126. 1725. 172. *Hermannia frutescens*, foliis oblongis, ad apices solum modo, ferratis.
- No. 412. p. 221. 1728. 326. *Hermannia frutescens*; folio Ibis, hirsuto, molli, caule piloso. Boerh. Ind. 1. 115.
- No. 412. p. 221. 1728. 328. *Hermannia*; minimo Alni folio. *An Ketmia, Africana fruticans & erecta Alni foliis triplo minoribus*. Hort. Amst. p. 2. 155?
- No. 422. p. 225. 1730. 428. *Herniaria glabra*. J. B. III. 378.
- No. 422. p. 225. 1730. 429. *Herniaria hirsuta*. J. B. III. 379.
- No. 383. p. 94. 1723. 75. *Hieracium Castorei* odore nostras. *Hieracium Cichorei, vel potius Stæbes folio, hirsutum*. Raii Cat. Cantab.
- No. 417. p. 2. 1729. 373. *Hieracium fruticosum*; angustissimo, incano folio. H. L. Bat. 316.
- No. 417. p. 2. 1729. 374. *Hieracium Pulmonaria dictum*, latifolium, humilius; ramulis expansis.
- No. 383. p. 94. 1723. 74. *Hieracium Pyrenaicum Blattariæ folio*, minus hirsutum. Schol. Bot.
- No. 376. p. 281. 1722. 22. *Horminum sylvestre latifolium*, verticillatum C. B. 238.
- No. 376. p. 281. 1722. 23. *Hypericum perfoliatum & perforatum*. T. Inst. 255.
- No. 376. p. 282. 1722. 24. *Jacea altissima*, folio dissecto, capite Ovarii nudo. D. Vaillant.
- No. 407. p. 2. 1727. 276. *Jacea cum squamis pennatis, sive capite villoso*. J. B. 3. 28.
- No. 376. p. 282. 1722. 25. *Jacea Lusitanica*, semper virens. H. Reg. Par.
- No. 395. p. 126. 1725. 173. *Jacobæa Africana*, frutescens, flore amplo purpureo elegantissimo, Senecionis folio, Volk. Flor. Norimb.
- No. 412. p. 221. 1728. 329. *Jacobæa Hispanica*, minus laciniata; petalis brevissimis. T. Inst. 486.
- No. 376. p. 282. 1722. 26. *Jacobæa perennis Asplenii folio*. D. Vaillant.
- No. 395. p. 126. 1725. 174. *Jacobæa Sicula*, Chrysanthemi facie Boc. rar. p. 66.



330. *Jasminum Arabicum*; Castaneæ folio; flore albo, No. 412. p. 221. Ann. 1728.  
odoratissimo; cujus fructus Coffy in officinis. Boerh.  
Ind. alt. 217. *Arbor Yemenfis fructum Cofè ferens. D.*  
*Douglas.*
220. *Kali spinosum*, foliis longioribus & angustioribus T. No. 399 p. 294. 1726.  
Inst. 247.
221. *Kali spinosum* foliis crassioribus & brevioribus, T. No. 399. p. 294. 1726.  
Inst. 247.
277. *Ketmia Syrorum* quibusdam. C. B. 316. No. 407. p. 2. 1727.
222. *Lactuca Canadensis*, altissima latifolia, flore leuco- No. 399. p. 294. 1726.  
phæo T. Inst. 474.
335. *Lactuca perennis*, humilior; flore cœruleo. T. Inst. No. 412. p. 221. 1728.  
473.
375. *Lamium Garganicum*, subincanum; flore purpurasc- No 417. p. 2. 1729.  
ente; cum labio superiori crenato. Micheli Hort.  
Pisan. 93. Tab. 32.
376. *Lamium orientale*, argentatum, annuum; flore albo. No. 417. p. 3. 1729.  
*Lamium Moschatum foliorum marginibus argentatis.*  
*Wheeleri Itin.*
377. *Lamium purpureum*, perenne; foliis acutis profunde No. 417. p. 3. 1729.  
incisis. *Lamium; folio oblongo; flore rubro. Park.*  
*Theat.* 606.
223. *Lathyrus sylvestris* major flore minore; foliis longius No. 399. p. 294. 1726.  
mucronatis.
224. *Lavendula folio dissecto*, C. B. 216. No. 399. p. 294. 1726.
279. *Linaria cærulea*, foliis brevioribus, & angustioribus. No. 407. p. 2. 1727.  
Raii Syn. Ed. 3. 282.
278. *Linaria capillaceo folio*. C. B. 213. No. 407. p. 2. 1727.
333. *Linaria Hispanica*, procumbens; foliis uncialibus, No. 412. p. 221. 1728.  
glaucis, flore flavescente, pulchrè striato labiis nigro-  
purpureis.
332. *Linaria lutea* elatior & ramosior; flore minori. No. 412. p. 221. 1728.
334. *Linaria multicaulis*, erecta annua, angusto Mollugi- No. 412. p. 221. 1728.  
nis folio; floribus luteis rarè dispositis.
331. *Linaria vulgaris* lutea; flore majore. C. B. 212. No. 412. p. 221. 1728.
27. *Lotus pentaphyllos* minor hirsutus, filiqua angustif- No. 376. p. 282. 1722.  
sima C. B. 332.
28. *Lunaria vasculo sublongo intorto*. Raii Syn. 164. No. 376. p. 282. 1722.
175. *Lychnidea Virginiana*, *Holostei* ampliore folio, flo- No. 395. p. 126. 1725.  
ribus umbellatis purpureis.
231. *Lychnis frutescens*, *Myrtifolia*, Been albo similis No. 399. p. 295. 1726.  
C. B. 205.
378. *Lychnis Hispanica*; folio *Kali*; multiflora. T. Inst. No. 417. p. 3. 1729.  
338.
225. *Lychnis Hispanica* major latifolia flore albo. No. 399. p. 294. 1726.



- No. 376. p. 282. Ann. 1722. 29. *Lychnis Linifolia* torosis & laxioribus capitulis. Bar. obs. 64.
- No. 399. p. 294. 1726. 227. *Lychnis maritima* Anglica, amplioribus foliis.
- No. 399. p. 294. 1726. 226. *Lychnis maritima* repens, C. B. 205.
- No. 399. p. 294. 1726. 228. *Lychnis Orientalis* Bupleuri folio T. Cor. 24.
- No. 399. p. 294. 1726. 229. *Lychnis Orientalis* calyce pyramidato, striato, longissimo; T. Cor. 24.
- No. 399. p. 294. 1726. 230. *Lychnis Orientalis* foliis carnosissimis; caule ramosissimo; flosculis minutis onusto. *Lychnis Orientalis Saponariæ* folio & facie, flore parvo & multiplici.
- No. 383. p. 94. 1723. 76. *Lychnis Orientalis* longifolia, nervosa, flore purpurascens T. Cor. 24.
- No. 399. p. 295. 1726. 232. *Lychnis segetum* Meridionalium annua, hirsuta; floribus rubris, uno versu dispositis. Boer. Ind. alt. 214.
- No. 399. p. 295. 1726. 234. *Lychnis sylvestris* viscosa, rubra altera C. B. 205.
- No. 399. p. 295. 1726. 233. *Lychnis sylvestris* viscosa rubra angustifolia, C. B. 205.
- No. 399. p. 295. 1726. 235. *Lychnis umbellifera*, montana, Helvetica. Zanon. 128.
- No. 399. p. 295. 1726. 236. *Lyfimachia bifolia* flore globoso. C. B. 245.
- No. 422. p. 225. 1730. 430. *Lyfimachia spicata*; flore albo; Salicis folio T. Inst. 141.
- No. 376. p. 282. 1722. 30. *Majorana Cretica*, Origani foliis, villosa Satureiæ odore, corymbis majoribus albis. T. Cor. 13. *Origanum Smyrnæum Wheeleri*.
- No. 383. p. 94. 1723. 81. *Malva erectior*, flore magno, suaverubente. T. Cor. 2.
- No. 383. p. 94. 1723. 78. *Malva Lusitanica*, annua, flore parvo striato.
- No. 383. p. 94. 1723. 80. *Malva Or. erecta*, major, flore vix conspicuo. D. Sherard.
- No. 383. p. 94. 1723. 77. *Malva Sinensis*, annua, erecta flore minimo. *Ki-tsai-tse dicta*.
- No. 383. p. 94. 1723. 79. *Malva sylvestris*, foliis sinuatis minoribus, flosculis minimis, Anglica. Boer, Ind. 2. 268.
- No. 383. p. 95. 1723. 82. *Malva Syriaca*, *Ela Haur taunal dicta*. *Malva Cretica*, annua, altissima, flore parvo, ad alas umbellato. T. Cor. 2.
- No. 399. p. 295. 1726. 242. *Malvinda Abutili* folio, flore luteo spicato. *Althæa Indica Abutili subrotundo folio, flore luteo spicato*. Pluk. Phyt. Tab. 74. fig. 6.
- No. 399. p. 295. 1726. 243. *Malvinda Abutili* folio; flore luteo spicato minor.
1731. 475. *Malvinda Ficus* folio, floribus luteis, in umbella foliacea nascentibus.
- No. 399. p. 295. 1726. 240. *Malvinda Pimpinellæ* majoris folio, angustiori semine bidente.



239. *Malvinda Pimpinellæ majoris folio, femine bidentate.* No. 399 p. 295. Ann. 1726.
241. *Malvinda profundius ferrato folio, femine tridente.* No. 399. p. 295. 1726.
238. *Malvinda Ulmifolia femine bidente. Malva Ulmifolia, femine cum gemino rostro, T. Inst. 96.* No. 399. p. 295. 1726.
237. *Malvinda Ulmifolia femine rostrato. Malva annua fruticosa Fernambucana flore luteo, Zanon. 132.* No. 399. p. 295. 1726.
474. *Malvinda Xanthii fere folio, fructu lappaceo, pentacocco. Trifolio affinis, Indiæ Orientalis Xanthii facie Breyn. Cent. Tab. 135.* 1731.
176. *Marrubium album, foliis amplis, ferè circinatis.* No. 395. p. 126. 1725.
31. *Marrubium Hispanicum supinum, foliis sericeis argenteis T. Inst. 192.* No. 376. p. 282. 1722.
476. *Martynia annua villosa & viscosa folio subrotundo flore magno rubro. D. Houstoun.* 1731.
439. *Medica echinata, minima. J. B. 11. 386.* No. 422. p. 226. 1730.
436. *Medica fructu ovali spinoso. Medica συναρπῶ fructu ovali; spinulis brevioribus & rigidioribus. R. Hist. 963.* No. 422. p. 225. 1730.
432. *Medica hirsuta, echinis rigidioribus. J. B. 11. 385.* No. 422. p. 225. 1730.
438. *Medica Hispanica; fructu echinato, subhirsuto, sphaeroide.* No. 422. p. 225. 1730.
433. *Medica magna, turbinata. J. B. 11. 385.* No. 422. p. 225. 1730.
440. *Medica marina Lob. icon. 38. Trifolium cochleatum, maritimum, tomentosum. C. B. 329.* No. 422. p. 226. 1730.
435. *Medica maritima, nostras; modiolis spinosis. Trifolium cochleatum; modiolis spinosis. Raii Syn. Ed. 2. 197.* No. 422. p. 225. 1730.
437. *Medica Orientalis; fructu rotundiore, subhirsuto, tuberculis raris obfito.* No. 422. p. 225. 1730.
431. *Medica scutellata. J. B. 11. 384.* No. 422. p. 225. 1730.
434. *Medica tornata, minor, lenis Park. Theat. 1116.* No. 422. p. 225. 1730.
441. *Melilotus Messanensis, procumbens; folliculis rugosis, sublongis; spicis florum brevioribus. Raii Hist. 952.* No. 422. p. 226. 1730.
386. *Mentha Sisymbrium, dicta, hirsuta, rotundifolia; odore Aurantii D. Manningham. Mentha, Sisymbrium dicta, hirsuta; glomerulis & foliis minoribus ac rotundioribus. Raii Syn Ed. 3. 233.* No. 417. p. 3. 1729.
380. *Millefolium alburn, incanum; segmentis foliorum latioribus.* No. 417. p. 3. 1729.
385. *Millefolium; foliis Sophiæ fere divisura; floribus parvis, ex albo flavescentibus.* No. 417. p. 3. 1729.
383. *Millefolium, minus, tenuifolium; Tanaceti odore Barrel. obs. N°. 1117.* No. 417. p. 3. 1729.
381. *Millefolium nobile Tragi. 476.* No. 417. p. 3. 1729.



- No. 417. p. 3. Aon 1729. 382. Millefolium, odoratum, Monspeliense Pillet. 271.  
 No. 417. p. 3. 1729. 384. Millefolium, tomentosum, luteum C. B. 140.  
 No. 417. p. 3. 1729. 379. Millefolium, vulgare, album. C. B. 140.  
 No. 383. p. 95. 1723. 83. Mimosa Jamaicensis Zanon. Hist. 149.  
 No. 399. p. 295. 1726. 244. Moldavica Betonicæ folio, flore cœruleo T. Inst. 184.  
 No. 399. p. 295. 1726. 245. Moldavica Orientalis, Betonicæ folio flore magno violaceo T. Cor. 11.  
 No. 395. p. 126. 1725. 177. Myosotis Hispanica segetum. T. Inst. 245.  
 No. 395. p. 126. 1725. 178. Myosotis Orientalis perfoliata, Lychnidis folio, T. Cor. 18.  
 No. 399. p. 295. 1726. 247. Myrrhis folio Podagrariæ Rivin.  
 No. 417. p. 3. 1729. 387. Myrrhis trifolia, Canadensis, Angelicæ facie T. Inst. 315.  
 No. 399. p. 295. 1726. 246. Myrrhis tuberosa, nodosa, coniophyllon Moris, Umb. 67.  
 No. 399. p. 295. 1726. 248. Niruri Barbadenſe, folio ovali subtus glauco, pediculis florum brevissimis.  
 No. 422. p. 226. 1730. 442. Ornithopodium scorpioides; filiqua compressa T. Inst. 400.  
 No. 422. p. 226. 1730. 443. Papaver luteum, perenne; laciniato folio; Cambro-britanicum Raii Syn. Ed. 3. 309. *Argemone lutea Cambro-britanica. Park. Theat. 369.*  
 No. 422. p. 226. 1730. 444. Papaver spinosum C. B. 171.  
 No. 412. p. 221. 1728. 336. Parietaria officinarum & Dioscoridis. C. B. 121.  
 No. 412. p. 221. 1728. 337. Parietaria vulgaris, Anglica. *Parietaria minor, Oci-mi folio C. B. 121.*  
 No. 412. p. 221. 1728. 338. Partheniastrum Americanum; Ambrosiæ folio. Ac. Reg. Sc. Par.  
 No. 395. p. 126. 1725. 180. Pentaphylloides Canadense, folio Agrimonix. Sarra-cen. D. Vaillant.  
 No. 395. p. 126. 1725. 179. Pentaphylloides erectum. J. B. 2. 398.  
 No. 395. p. 126. 1725. 181. Pentaphylloides Fragariæ folio, Bot. Monſp. Ap. 309.  
 No. 395. p. 126. 1725. 182. Pentaphylloides Fragariæ folio & crenis obtusioribus.  
 No. 376. p. 282. 1722. 33. Pentaphylloides fruticosa. Raii Syn. 142.  
 No. 376. p. 282. 1722. 32. Pentaphylloides palustre rubrum T. Inst. 298.  
 No. 407. p. 2. 1727. 283. Perfoliata vulgatissima sive arvensis. C. B. 277.  
 No. 407. p. 2. 1727. 280. Persicaria mitis. J. B. 3. 779.  
 No. 407. p. 2. 1727. 281. Persicaria mitis major; foliis pallidioribus D. Bobart. Raii. Syn. Ed. 2. 58.  
 No. 407. p. 2. 1727. 282. Persicaria orientalis, Nicotianæ folio; calyce florum purpureo T. Cor. 38.  
 No. 395. p. 127. 1725. 187. Phlomis fruticosa, humilis, latifolia, candidissima; floribus luteis.  
 No. 376. p. 282. 1722. 34. Phlomis fruticosa, Salviæ folio latiore & rotundiore. T. Inst. 177.



35. *Phlomis fruticosa*, *Salviæ folio longiore & angustiore* No. 376. p. 283. Ann. 1722.  
T. Inst.
188. *Phlomis Orientalis*, *lutea*, *herbacea*, *latifolia*, *verticillata*. No 395. p. 127. 1725.
36. *Phlomis Orientalis lutea*, *angustifolia cymis fulvescentibus* D. Sherard. No. 376. p. 283. 1722.
37. *Phlomis Samia herbacea*, *Lunariæ foliis*. T. Cor. 10. No. 376. p. 283. 1722.
389. *Pimpinella major*, *rigida*, *præalta*, *auriculata*, *Sabauda*. Bocc. Mus. p. 19. No. 417. p. 3. 1729.
388. *Pimpinella Sanguisorba major*. C. B. 160. No. 417. p. 3. 1729.
479. *Polium erectum*, *album*, *angustiori folio & spica*. 1731.
478. *Polium montanum album* C. B. 221. 1731.
477. *Polium montanum luteum* C. B. 220. 1731.
480. *Polium Pyrenaicum*, *supinum*, *Hederæ terrestris folio* T. Inst. 266. 1731.
481. *Polium supinum*, *angusto*, *minime crenato folio*, *flore flavescente*. 1731.
284. *Portulaca Corassavica procumbens*; *Capparidis folio*; *flore muscoso*; *capsula bifurcata*. Parad. Bat. 213. No. 407. p. 2. 1727.
445. *Pseudo-Ipecacuanha Noveboracensis* D. Colden. No. 422. p. 226. 1730.
- An *Peryclymenum herbaceum*, *erectum*, *Virginianum*,  
Dr Tinkers-weed, *vulgo vocatum*? Pluk. Alm. 287.  
Phyt. T. 104. f. 2?
446. *Ptarmica Agerati folio*, *acutiori*. *Ageratum album* No. 422. p. 226. 1730.  
vulgo.
38. *Ptarmica Orientalis pinnulis cristatis*. T. Cor. *Ab-* No. 376. p. 283. 1722.  
*sinthium Santonicum Ægyptiacum* C. B. 319.
39. *Quinquefolium album majus alterum* C. B. 325. No. 376. p. 283. 1722.
483. *Quinquefolium foliis profunde & eleganter incis*, 1731.  
*flore luteo*, *petalis cordatis* Cat. Plant. Agr. Florent.  
Hort. Pisan.
186. *Quinquefolium folio argenteo* C. B. 325. No. 395. p. 127. 1725.
482. *Quinquefolium folio subtus argenteo majus*. An 1731.  
*Quinquefolium Pyrenaicum*, *folio subtus argenteo* Tourn.  
Inst. 297.
185. *Quinquefolium minus*, *flore pallide luteo*. T. Inst. No 395. p. 127. 1725.  
297.
484. *Quinquefolium minus repens luteum* C. B. 325. 1731.
184. *Quinquefolium quod Pentaphyllum*, *seu potius* No. 395. p. 126. 1725.  
*Heptaphyllum rectum*, *caule rubro*, *hirsutius* H.  
Cath. Boer. Ind. 2. 40.
183. *Quinquefolium rectum luteum*. C. B. 325. No. 395. p. 126. 1725.
447. *Ranunculus arvensis*, *echinatus*. C. B. 179. No. 422. p. 226. 1730.
448. *Ranunculus arvensis*; *feminibus magis echinatis* D. No. 422. p. 226. 1730.  
Sherard. Boer. Ind. alt. 32.



- No. 407. p. 2. Ann. 1727. 285. *Ranunculus hirsutus*, annuus; flore minimo. Raii Syn. Ed. 2. 135.
- No. 383. p. 95. 1723. 84. *Rhagadiolus alter*. Cæsalp. 511.
- No. 383. p. 95. 1723. 85. *Rhagadiolus Lampfanæ foliis*. T. Cor. 36.
- No. 417. p. 4. 1729. 391. *Ribes Americana*; fructu nigro minimo; calyce floris campaniformi.
- No. 417. p. 3. 1729. 390. *Ribes fructu parvo*. Merret. Pin. Raii Syn. Ed. 3. 456.
- No. 412. p. 221. 1728. 339. *Ricinoides arbor*; Americana; folio multifido. T. Inst. 656.
- No. 407. p. 3. 1727. 286. *Ricinus minor Staphys agriæ folio*; flore pentapetalo purpureo Sloane. Hist. Vol. I. 129. Tab. 84.
- No. 376. p. 283. 1722. 41. *Rubus odoratus* Cornut. 150.
- No. 376. p. 283. 1722. 40. *Ruta Chalepensis*; latifolia, florum petalis villis scamentibus H. L. Bat. 431.
- No. 422. p. 226. 1730. 449. *Ruyfchiana*; flore cœruleo, magno. Boerh. Ind. alt. 173. *Chamæpitys cœrulea austriaca* C. B. 250.
- No. 383. p. 95. 1723. 86. *Salvia Or. Absinthium redolens*, foliis pinnatis, flore carneo; elatior. D. Sherard.
1731. 485. *Salvia Or. foliis alatis* D. Sherard. *Salvia Orientalis latifolia, hirsutissima, viscosa, pinnata, flore & calyce purpureis, inodora* Boer. Ind. alt. 167. cum fig. opt.
1731. 486. *Salvia Or. foliis alatis major. Horminum Chalepense, alato folio, flore majore rubicundo*. Hist. Ox. III. 394.
- No. 407. p. 3. 1727. 297. *Santolina canescens foliis Cupressi. an 4* Dodon. 269?
- No. 407. p. 3. 1727. 292. *Santolina foliis minus incanis*. T. Inst. 461.
- No. 407. p. 3. 1727. 293. *Santolina foliis obscure virentibus* T. Inst. 461.
- No. 407. p. 3. 1727. 290. *Santolina foliis teretibus*. T. Inst. 460.
- No. 407. p. 3. 1727. 295. *Santolina incana*; Chamamæli odore suaviore. Boerh. Ind. alt. 123.
- No. 407. p. 3. 1727. 298. *Santolina minor candidissima*.
- No. 407. p. 3. 1727. 291. *Santolina repens & canescens*. T. Inst. 460.
- No. 407. p. 3. 1727. 296. *Santolina tota viridis*; foliis Ericæ aut Sabinæ. an. 3. Dodon. 269?
- No. 407. p. 3. 1727. 294. *Santolina vermiculata cretica* T. Inst. 461.
- No. 412. p. 221. 1728. 340. *Satureia montana*. C. B. 218.
- No. 412. p. 221. 1728. 341. *Satureia montana*; latiori folio; ramulis minus erectis.
- No. 383. p. 95. 1723. 88. *Scabiosa altissima*, annua, foliis Agrimonix nonnihil similibus. H. L. B. 539.
- No. 383. p. 95. 1723. 87. *Scabiosa annua, Centauroides fistulosa*. H. Cath.
- No. 417. p. 4. 1729. 392. *Sclarea*; Africana; amplissimo folio; annua. Boer. Ind. alt. 165.
- No. 412. p. 222. 1728. 342. *Sclarea folio Salviæ, minor, sive glabra* T. Inst. 180.
- No. 412. p. 222. 1728. 343. *Sclarea folio triangulari; caule tomentoso*. T. Inst. 180.
- No. 376. p. 283. 1722. 42. *Sclarea Orientalis, Betonicæ folio acutissimo, comâ purpurascente*. T. Cor. 10.



189. *Sclarea rugoso, verrucoso & laciniato folio*, T. Inst. 180 No. 395. p. 127. Ann. 1725.  
 43. *Securidaca lutea major*. C. B. 348. No. 376. p. 283. 1722.  
 289. *Sena spuria, arborea, spinosa, foliis alatis ramosis, seu decompositis; flore ex luteo & rubro specioso*. Sloan. Hist. Vol. II. 49. No. 407. p. 3. 1727.  
 190. *Senecio Ægyptius, folio Matricariæ*. Boer. Ind. 1. p. 40 No. 395. p. 127. 1725.  
 249. *Senecio Virginianus, arborefcens, Atriplicis folio*. Par. Bat. 225. No. 399. p. 296. 1726.  
 193. *Serratula annua, feminibus nitidissimis ad basin compressis. Senecio carduus Apulus*, Col. p. 1, 32. No. 395. p. 127. 1725.  
 194. *Serratula annua, feminibus nitidissimis, majoribus & minime compressis. Crupina Belgarum vulgo*. No. 395. p. 127. 1725.  
 250. *Sherardia Teucris folio flore purpureo*. Vaillant. Disc. p. 49. *Verbena folio subrotundo, serrato; flore cæruleo*, Sloan Hist. Vol. I. p. 171. Tab. 107. f. 1. No. 399. p. 296. 1726.  
 191. *Sideritis arvensis, latifolia, glabra*. C. B. 233. No. 395. p. 127. 1725.  
 393. *Sideritis Cretica, viscosa, Bitumen olens*. Zanon 186. No. 417. p. 4. 1729.  
 192. *Sideritis vulgaris hirsuta erecta*. C. B. 233. No. 395. p. 127. 1725.  
 287. *Sonchus levis in plurimas, & tenuissimas, lacinias divisus*. C. B. 124. No. 407. p. 3. 1727.  
 288. *Spinacia Cretica supina; capsula feminis aculeata*. T. Inst. 533. No. 407. p. 3. 1727.  
 89. *Stachys Cretica*. C. B. 236. No. 383. p. 95. 1723.  
 90. *Stachys Cretica foliis sub verticillis latioribus, acuminatis, flore majore*. No. 383. p. 95. 1723.  
 94. *Stachys elatior flore flavescente punctato*. No. 383. p. 95. 1723.  
 92. *Stachys folio obscure virente, flore ferrugineo*. H. Ox. 3. 382. No. 383. p. 95. 1723.  
 91. *Stachys major Germanica*. C. B. 236. No. 383. p. 95. 1723.  
 93. *Stachys Salviæ folio, flore luteo*. D Jussieu. No. 383. p. 95. 1723.  
 487. *Stramonium Ægyptiacum, flore intus albo, foris violaceo* Tourn. Inst. 119. 1731.  
 488. *Stramonium ferox* Boccon. rar. 50. 1731.  
 195. *Teucrium Bæticum*, Clus. Hisp. 229. No. 395. p. 127. 1725.  
 196. *Teucrium Bæticum humilius, & ramosius, folio subrotundo*. No. 395. p. 127. 1725.  
 197. *Thlaspi arvense, Vaccariæ incano folio, majus*, C. B. 206. No. 395. p. 127. 1725.  
 44. *Thlaspi Halimi folio, semper virens*. H. L. Bat. *Alyson T.* 217. No. 376. p. 283. 1722.  
 198. *Thlaspi Vaccariæ incano folio, minus*. C. B. 206. No. 395. p. 127. 1725.  
 489. *Tithymalus Americanus, hastato folio, pediculum versus contractiore, & utrinque sinuato*. D. Houston. 1731.  
 491. *Tithymalus Creticus, characias, angustifolius & incanus* Tourn. Cor. 1. 1731.



- Ann. 1731. 490. *Tithymalus Cyparissias* C. B. 291.  
 No. 407. p. 3. 1727. 299. *Tithymalus erectus*, acris; *Parietariæ* foliis glabris; floribus ad caulium nodos conglomeratis. Sloane Hist. V. I. 197. Tab. 126.  
 1731. 493. *Tithymalus* foliis subrotundis, non crenatis, *Peplus* dictus R. Syn.  
 1731. 492. *Tithymalus helioscopius* C. B. 291.  
 1731. 494. *Tithymalus latifolius*. an *Tithymalus latifolius Hispanicus* C. B. 291?  
 1731. 495. *Tithymalus maritimus*, minor, *Portlandicus* D. Stone- street Raii Syn. Ed. 3. 313. Tab. 24. f. 6.  
 1731. 496. *Tithymalus Myrsinites*, *latifolius* C. B. 290.  
 1731. 497. *Tithymalus tuberosa*, *Pyriformi* radice C. B. 272.  
 1731. 498. *Tithymalus villosus*, folio lato & obtuso nervo medio, insigniter albicante. *Tithymalus Hibernicus* Merret. Pin. Raii Syn. 183.  
 No. 407. p. 3. 1727. 300. *Tormentilla reptans*, alata, foliis profundius serratis D. Plot. R. Syn. Ed. 2. 142.  
 No. 412. p. 222. 1728. 344. *Tribulus terrestris*. J. B. 2. 352.  
 No. 412. p. 222. 1728. 345. *Tribulus terrestris*, hexaphyllos, *Americanus*. An *Tribulus terrestris major*; flore maximo, odorato. Sloan. Hist. Vol. I. p. 209. Tab. 132. f. 1?  
 No. 412. p. 222. 1728. 346. *Trifolium*, angustifolium spicatum. J. B. 2. 376.  
 No. 412. p. 222. 1728. 347. *Trifolium avense*, humile; spicatum sive *Lagopus*. C. B. 328. foliis latioribus. *Lagopodium Lagopus*. Tab. icon. 524.  
 No. 412. p. 222. 1728. 348. *Trifolium*, *Lagopus* dictum, angustioribus foliis. *Lagopus* Lob. icon. 39.  
 No. 376 p. 283. 1722. 45. *Trifolium peltatum* Creticum. C. B. Prod. 142.  
 No. 412. p. 222. 1728. 350. *Trifolium pratense*, folliculatum. C. B. 329.  
 No. 412. p. 222. 1728. 349. *Trifolium pratense*, hirsutum, majus, flore albo sulphureo R. Syn. Ed. 2. 193.  
 1731. 499. *Valerianella Cornucopioides* rubra Mor. Umb.  
 No. 422. p. 226. 1730. 450. *Veronica fruticosa*, erecta, dulcis, hexangulari caule; flore dilute cœruleo. Sloan. Cat. Jam. 81. Hist. Tab. 108. f. 2.  
 No. 417. p. 4. 1729. 394. *Veronica minor*, Alpina, *Serpylli* folio. An *Ponæ*?  
 No. 376. p. 284. 1722. 47. *Veronica multicaulis* Pannonica. T. Inst. 145.  
 No. 376. p. 283. 1722. 46. *Veronica spicata* hirsuta, folio subrotundo serrato.  
 No. 383. p. 95. 1723. 95. *Vicia Craccæ* majori Gerardi similis, per omnia minor Anglica.  
 No. 383. p. 95. 1723. 100. *Vicia multiflora*, Cassubica, frutescens, *Lentis* siliqua. Breyn. Prod. 52.  
 No. 383. p. 95. 1723. 96. *Vicia supina*, latissimo folio, non serrato. T. Inst. 397.  
 No. 383. p. 95. 1723. 97. *Vicia supina*, latissimo folio, serrato. T. Inst. 397.  
 98 *Vicia*



98. *Vicia sylvestris*, incana, major & præcox, Parisien- No. 383. p. 95. Ann. 1723.  
fis, flore fuaverubente. T. Inst. 397.
99. *Vicia sylvatica maxima* Phyt. Britan. 129. *Vicia sylva-* No. 383. p. 95. 1723.  
*tica multiflora maxima*. R. Syn. 189.
50. *Virga aurea altissima*, ferotina, paniculâ speciosâ, pa- No. 376. p. 284. 1722.  
tulâ.
397. *Virga aurea Americana*, altissima, angustifolia feroti- No. 417. p. 4. 1729.  
na ; radice repente.
396. *Virga aurea Americana angustifolia*, media ; panicu- No. 417. p. 4. 1729.  
la speciosa.
49. *Virga aurea angustifolia*, paniculâ speciosâ, Canaden- No. 376. p. 284. 1732.  
fis H. Reg. Par.
199. *Virga aurea Canadensis*, Asterisci folio. Par. Bat. No. 395. p. 127. 1725.  
244.
48. *Virga aurea floribus fistulosis*, Senecionis instar, foliis No. 376. p. 284. 1722.  
angustioribus non ferratis. H. Ox. p. 3. 125.
398. *Virga aurea*; humilis; foliis rigidis, latis utrinque No. 417. p. 4. 1729.  
acuminatis. *An Virga aurea folio hirsuto, Salicis, raro*  
*& levissime serrato ; caulibus atropurpureis Boerb. Ind.*  
*alt. 97 ?*
395. *Virga aurea*, Mexicana. C. B. 517. *Virga aurea ; Li-* No. 417. p. 4. 1729.  
*monii folio ; paniculâ uno versu disposita* H. Reg. Par.
400. *Virga aurea minor* ; foliis ferratis, utrinque acumi- No. 417. p. 5. 1729.  
natis.
399. *Virga aurea*, montana ; folio angusto, sub incano ; No. 417. p. 4. 1729.  
flosculis conglobatis. Raii Syn. Ed. 2. 81.
200. *Virga aurea*, montana, Scrophulariæ folio, Icon. Ro- No. 395. p. 127. 1725  
bert. Pluk. Phyt. Tab. 235. f. 3.
500. *Xanthium Lusitanicum spinosum* Par. Bat. 439. 1731.

XXXII. 1. In § II. He dissects a Pear, which he says is entirely composed of the Pipes in the Stalk, dilated into a soft and moist Pulp, like what they antiently called the *Parenchyma*, that composes the Liver and Spleen, which he affirms to be pure Vessels, not Glands distinguished by being enveloped with one proper Membrane. You may, if you please, call the Pear, the Liver and the Spleen, taken in the whole, a Gland ; but he denies any particular Glands in their Composition.

*An Account of  
a Book, entitu-  
led, Adversa-  
riorum Ana-  
tomico-Medi-  
co-Chirurgi-  
corum Decas  
tertia. Auctore  
Frederico  
Ruyfch,*

2. The Plants are of their natural Bigness, exactly designed after the Life, and with great Accuracy and Success printed in their proper Colours. This curious Invention was never more aptly applied, though I think this is the first time it has been used in *Botany*. By this Means, without a long tedious Description, a Plant may be known by meer Inspection. However, that nothing may be wanting, the Author has thought fit to give short Descriptions, insisting

*M. D. Ana-  
tom. & Botan.  
Prof. Amstel.  
R. S. S. No.  
379. p. 428.*

*An Account of  
the first De-  
cade of a Book,*



*intituled, Jo-  
annis Mar-  
tyn Historia  
Plantarum ra-  
riorum. Prin-  
ted at Lon-  
don; by Ri-  
chard Reily,  
1728. by Mr  
Rand, F.R.S.  
No. 407. p.  
4.*

more particularly on those minute Parts which cannot be so clearly expressed by Sculpture; and has added, where they could be obtained, some Account of their Uses, &c.

The Author proposes, in the Sequel of this Work, to give an Account of new Plants only, or at least such as have not been figured by others: If he proceeds with the same Exactness, as I do not doubt he will, the Work very well deserves Encouragement; for of Plants thus figured and described, there can be no future Doubts.

Happy had it been for us, had the Antients left such Types or Descriptions of those they recommended as considerable for their Use in Medicine. This would have saved the Learned World much Labour and Study in an Enquiry, which, 'tis to be feared, for want of such Helps, will prove unsuccessful.

*The End of the Sixth VOLUME.*

























